Detailed Noise and Vibration Impact Statement

Parramatta Water Treatment Plant Discharge Line

Sydney Metro West – Western Tunnelling Package

ISSUE DATE: JULY 2023

Document Details

Document Title	**Detailed Noise & Vibration Impact Statement – Parramatta Water Treatment Plant Discharge Line**
Contract Name	**Sydney Metro West (SMW) – Western Tunnelling Package**
Client	**Sydney Metro**
GA Project No.	**00013/13065**
Principal Licensee	**Gamuda Australia Branch**
ABN	**27 632 738 768**
Project Address	**L8, 60 Station Street, Parramatta, NSW 2051**

DOCUMENT CONTROL

The current document version number and date of revision are shown in the document footer. All changes made to the document during its implementation on a live project are to be recorded in the amendment tables below.

Revision History

Revision	Date	Description of changes	Prepared by	Approved by
A	29/05/2023	Draft submission		
B	12/07/2023	Reviewed to address Sydney Metro, AA and ER's comments		
C	21/07/2023	Update to Consultation Summary (Attachment 14)		

Terms and Definitions

Term	Definition
AA	Acoustics Advisor
AA	Alternative Accommodation
AMM	Additional Mitigation Measures
AVTG	Assessing Vibration: a technical guideline (DEC, 2006)
CBD	Central Business District
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CNVIS	Construction Noise & Vibration Impact Statement
CNVMP	Construction Noise & Vibration Management Plan
CNVS	Construction Noise and Vibration Strategy
dBA	Decibels – measurement of noise
DNVIS	Detailed Noise and Vibration Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority
EPL	Environmental Protection Licence
ER	Environmental Representative (ER)
GLC	Gamuda Australia and Laing O'Rourke Consortium
HDPE	High Density Polyethylene
ICNG	Interim Construction Noise Guideline (DECC, 2009)
LA_{MAX}	the maximum sound level during a measurement period or a noise event
LB	Letter Box Drop
MCoA	Minister's Conditions of Approval
NCA	Noise Catchment Area
NML	Noise Management Levels
NDD	Non-Destructive Digging
NVMoP	Noise and Vibration Monitoring Program
OOHW	Out Of Hours Work
RBL	Rating Background Level
RO	Respite Offer
SMW	Sydney Metro West
SWL	Sound Powel Levels
WTP	Sydney Metro West Western Tunnelling Package Works (the Project)
WTP	Water Treatment Plant

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1 INTRODUCTION

This activity-specific Detailed Noise and Vibration Impact Statement (DNVIS) has been developed by Gamuda Australia Laing O'Rourke Consortium (GLC) to assess the potential noise and vibration impact of the proposed Parramatta Water Treatment Plant (WTP) discharge line. It accompanies the Project-wide DNVIS as well as the Noise and Vibration Management Plan (NVMP) as a sub-plan to the Construction Environmental Management Plan (CEMP) supporting the Sydney Metro West Stage 1 Western Tunnelling Package (WTP or 'the Project'). It also satisfies Ministers Conditions of Approval (MCoA) D43 and D44. A list of applicable requirements from the MCoA, Sydney Metro - Construction Environment Management Framework (CEMF) and the Sydney Metro CNVS is provided in Attachment 1.

The Project-wide DNVIS identifies the potential noise and vibration impacts from the Project based on noise and vibration modelling, as well as any noise and vibration mitigation measures required. The Project-wide DNVIS outlines *inter alia* the Project's full scope of works, approved construction hours and construction noise and vibration guidelines. The subject of this document is a site-specific DNVIS, which will act as an addition to the Project-wide DNVIS and should therefore be read in conjunction with this DNVIS. The Project-wide DNVIS can be found on the project website at https://gamuda.com.au/sydney-metro-west-western-tunnelling-package-wtp/

This DNVIS assesses the potential impact of the proposed Parramatta WTP discharge line. The discharge pipeline needs to be installed to connect the Parramatta construction site WTP to existing stormwater infrastructure outside of project boundaries. The discharge pipeline installation works have not been fully assessed in the EIS; they are however consistent with the original approval received for the Project. The consistency has been approved under GLC11_Consistency Assessment – Parramatta Water Treatment Plant Discharge.

This DNVIS has been developed to address the assessment requirements documented in the NSW Interim Construction Noise Guidelines (ICNG), Sydney Metro Construction Noise and Vibration Standard (CNVS), MCoA and any relevant Environmental Protection License (EPL) requirements. This DNVIS has been developed in consultation with the Environmental Representative (ER) and Acoustic Advisor (AA). A copy of this DNVIS will be provided to the AA and ER before the commencement of associated works. The AA will endorse this DNVIS before implementation in accordance with MCoA A36(e).

2 SCOPE OF WORKS

The Environmental Impact Statement (EIS) for the approved project describes a water treatment plant (WTP) to service the Parramatta construction site. Discharge of the treated water is described in the EIS as being to Parramatta River via existing local stormwater infrastructure, however details of installing the discharge pipeline was not assessed in detail. Treated water will be discharge to the estuarine reaches of the Parramatta River, downstream of Charles Street Weir via existing stormwater infrastructure at a maximum capacity of 10L/s. The existing stormwater infrastructure (stormwater pit) is located outside project boundary on the corner of George and Charles Street and therefore a large portion of the discharge pipeline will also be located outside the project boundary of the Parramatta construction site, for which noise and vibration impacts out of hours have not been assessed. The discharge pipeline will run from the northern side of the Parramatta construction site along George Street, to where the existing stormwater pit is located (indicated in Figure 1). The majority of the pipeline will be installed within the roadway. Note that in Figure 1 the proposed discharge pipeline is indicated in red, whilst the existing stormwater drainage network is indicated in green. The pipework outside project boundary will completely be installed underground. Due to traffic and community disruption, the works will need to be undertaken outside of standard working hours (evening and night) which is the subject of this DNVIS.

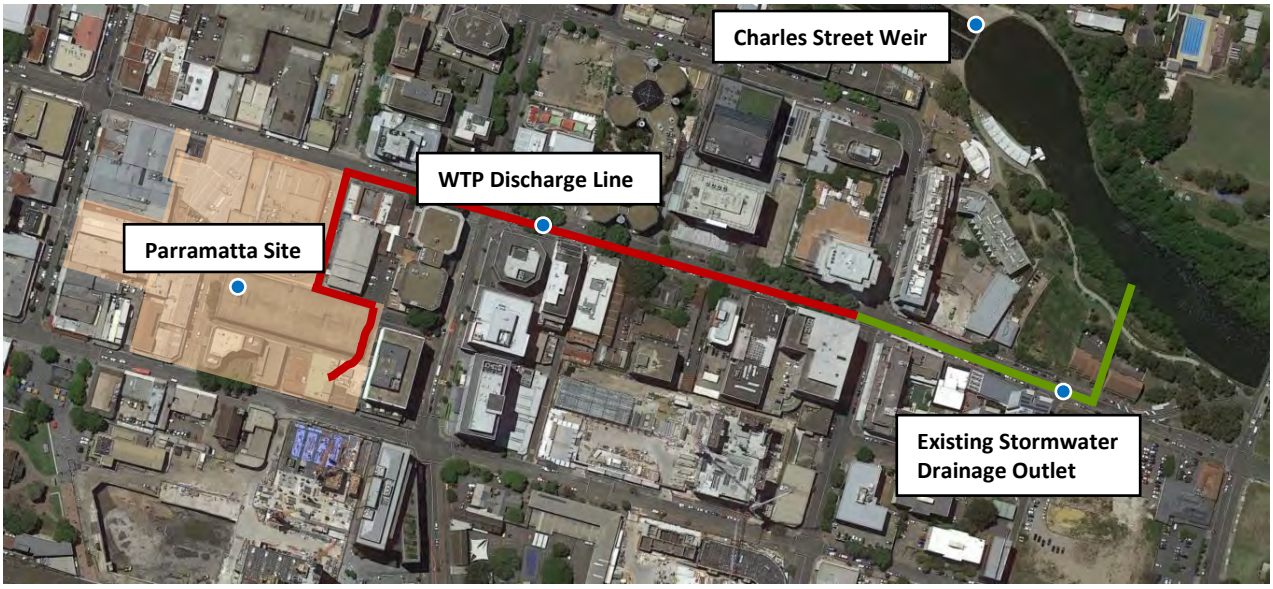

Figure 1: Location of WTP Discharge Pipeline Route

Works will include:

- Installation of 1 x 150mm diameter high density polyethylene (HDPE) pipe from the Parramatta WTP to connect to existing stormwater infrastructure, approximately 350m in length. This pipework will be installed outside the construction site from the north of the site, along George Street, to the stormwater pit located on the corner of George Street and Charles Street. A 150mm diameter pipe will furthermore be laid within the construction site to connect the water treatment plant to the high-density polyethylene (HDPE) discharge pipeline. This pipe will be installed above-ground using hand tools.
- Trenching through existing footpaths and roadways to a proposed maximum depth of 1.0m.
- Trenching will generally be through the roadways along George Street. A small portion of the trenching will be through the footpath along George Street, to connect to the conduit that was installed previously as part of the Non-Destructive Digging (NDD) investigation works described in GLC12 Environmental Review.

- Installation of a mechanical blocker, either a cover slab or steel plate over the previously installed conduit over the Parramatta Convict Drain.
- Removal of spoil and stockpiling at designated area on Project site for testing.
- Backfilling of the trenches using stabilised sand.
- Reinstatement of the road.
- Connection of the HDPE pipe (discharge pipeline) to the existing stormwater drainage pit on the corner of George Street and Charles Street.

These elements are shown in Appendix A.

The discharge pipeline will be installed in a number of smaller sections to ensure works can be reinstated or covered with steel plates at the end of each night to allow for normal traffic during the day. Equipment may include saw cutters, excavator, tipper truck, vac truck, bogie, lighting plant, plate compacter, light vehicle(s), and hand tools. The discharge pipeline will be connected to the top of the stormwater pit wall at a 90º bend by excavating to approximately 1.0m deep, using a core drill to create an opening for the discharge pipeline and using cement mortar, or similar, to seal. The trenches will be reinstated using stabilised sand (for backfilling) and hot mix asphalt.

The pipes will be joined via Butt Welding. Once sections of the discharge pipeline have been installed, they will be pressure tested to ensure they have been correctly installed and no risk of leaks are present. A final full system test will be undertaken once the complete discharge pipeline has been installed.

Discharge pipeline installation works will take approximately 5 weeks to complete. The works are planned to commence in August 2023. The works will commence from the north of the Parramatta construction site and progress east along George Street. The proposed works will occur out-of-hours (OOH) as the works are located on, across or adjacent to active roads and will require disruption to traffic and community via road / lane closures as well as restricted pedestrian access.

3 EXISTING NOISE ENVIRONMENT

3.1 Noise Catchment Area

The Project area has been divided into nine (9) Noise Catchment Areas (NCAs) as defined in the Sydney Metro West – Westmead to the Bays Concept and Stage 1 EIS. These NCAs reflect the ambient noise environment of that area, as well as the noise and vibration sensitivity of the surrounding land uses. The installation of the WTP discharge pipeline at the Parramatta Construction Site is proposed to be completed in Parramatta, which is across only one (1) identified NCA. The NCA is described in Table 1 and shown on Figure 2.

Table 1: Noise Catchment Areas – Westmead Metro Station Construction Site - Tunnel Support Activities

NCA	Description
NCA03	Predominantly covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University – Parramatta, Arthur Phillip High School, Parramatta Public School, and a number of nearby hotels and places of worship.

The residential NMLs and the NMLs for 'other sensitive' non-residential receivers, which were obtained from the Project's NVMP and DNVIS, for NCA03 have been indicated in Table 2 and Table 3 respectively. During OOHW the residential NML is determined as 5dB above the Rating Background Level (RBL) (i.e., RBL + 5dB).

Residential NMLs for the Project have been determined in accordance with the requirements of the ICNG and the Sydney Metro CNVS and the NMLs for 'other sensitive' non-residential land uses have been adopted from the ICNG, Sydney Metro CNVS, *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors*, and previous assessments undertaken for the Sydney Metro West Project (e.g., EIS and modification reports).

Figure 2: Noise Catchment Areas

Table 2: Project Residential NMLs

NCA	Receiver Type	Representative Logger Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level (52 dBA or RBL +15 dB whichever is higher) (L_{Amax} dBA)
			Approved Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
			Daytime	Daytime[1]	Evening	Night-time	Night-time
NCA03	Residential	B.03	68	63	58	48	58

Table 3: NMLs for Other Sensitive Receivers – ICNG

Land Use	Assessment Period	Noise Management Level $L_{Aeq(15minute)}$ (dBA)	
		Internal	External
ICNG 'Other Sensitive' Receivers			
Classrooms at schools and other educational institutions	When in use	45	55[1]
Hospital wards and operating theatres	When in use	45	65[2]
Places of worship	When in use	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	When in use	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	When in use	-	60
Commercial	When in use	-	70
Industrial	When in use	-	75
Non-ICNG 'Other Sensitive' Receivers			
Hotel[3]	Day / Evening	50	70[2]
	Night-time	40	60[2]
Café / Bar / Restaurant[3]	When in use	50	70[2]
Child Care Centres – Sleeping areas[4]	When in use	40	50[1]
Public Building	When in use	50	60[1]
Recording Studio	When in use	25	45[2]
Theatre/Auditorium	When in use	30	50[2]
Rosehill Gardens Racecourse Stables[5]	When in use	-	60

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 3: Adopted from AS2107.

Note 4: Adopted from *Association of Australian Acoustical Consultants Guideline for Child Care Centre Acoustic Assessment*.

Note 5: Adopted from the ICNG – passive recreation.

4 AIRBORNE NOISE IMPACT ASSESSMENT

4.1 Modelled Work Scenarios Summary

A noise model of the study area has been used to predict noise levels from the proposed construction work to all surrounding receivers. The project-specific noise prediction tool, KNOWnoise^{TM}, has been used to develop Construction Noise and Vibration Impact Statements (CNVIS) for the various stages of works. The works have been modelled in four (4) stages as they will progress along George Street (west to east) instead of as a cumulative impact on all the receivers every night. Furthermore, for each of the four (4) sections a separate CNVIS was prepared for (i) saw cutting, which will only be taking place during evening hours (6pm-10pm); (ii) non-destructive digging (NDD) and pavement removal, taking place during evening hours and night-time hours (6pm-7am); and (iii) installation of the pipeline and reinstatement of the surface (evening and night-time hours), considering these works will not be taking place at the same time.

The only activity that was modelled whilst taking mitigation measures into account is saw cutting, which has been adjusted with a reduction level of 3dB in KNOWnoise^{TM} which is defined in the software for: *a Noise barrier or other obstruction which just barely breaks the line-of-sight between the noise source and receiver*. Generally, noise blankets will be used around high noise impact works such as saw cutting, which would warrant a reduction of 5dB for the activity. However, in this assessment a conservative approach was adopted to model for the worst-case scenario. No other activities were modelled with mitigation measures considered due to the consistency of mitigation around all other activities being difficult to predict and a conservative approach was deemed best practice.

For the proposed works to install the WTP discharge pipeline during out of hours (OOH) at the Parramatta Metro Station construction site, twelve (12) individual construction noise and vibration impact assessments (CNVIAs) have therefore been prepared as follows:

- Sydney Metro West WTP CNVIS – Stage 1A – Saw Cutting (Section 1) (dated 2nd March 2023) – see Attachment 2; and
- Sydney Metro West WTP CNVIS – Stage 1B – NDD and Pavement Removal (Section 1) (dated 2nd March 2023) – see Attachment 3; and
- Sydney Metro West WTP CNVIS – Stage 1C – Installation of Pipeline and Reinstatement of Surface (Section 1) (dated 2nd March 2023) – see Attachment 4; and
- Sydney Metro West WTP CNVIS – Stage 2A – Saw Cutting (Section 2) (dated 2nd March 2023) – see Attachment 5; and
- Sydney Metro West WTP CNVIS – Stage 2B – NDD and Pavement Removal (Section 2) (dated 2nd March 2023) – see Attachment 6; and
- Sydney Metro West WTP CNVIS – Stage 2C – Installation of Pipeline and Reinstatement of Surface (Section 2) (dated 2nd March 2023) – see Attachment 7; and
- Sydney Metro West WTP CNVIS – Stage 3A – Saw Cutting (Section 3) (dated 2nd March 2023) – see Attachment 8; and
- Sydney Metro West WTP CNVIS – Stage 3B – NDD and Pavement Removal (Section 3) (dated 2nd March 2023) – see Attachment 9; and
- Sydney Metro West WTP CNVIS – Stage 3C – Installation of Pipeline and Reinstatement of Surface (Section 3) (dated 2nd March 2023) – see Attachment 10; and
- Sydney Metro West WTP CNVIS – Stage 4A – Saw Cutting (Section 4) (dated 2nd March 2023) – see Attachment 11; and
- Sydney Metro West WTP CNVIS – Stage 4B – NDD and Pavement Removal (Section 4) (dated 2nd March 2023) – see Attachment 12; and
- Sydney Metro West WTP CNVIS – Stage 4C – Installation of Pipeline and Reinstatement of Surface (Section 4) (dated 2nd March 2023) – see Attachment 13.

4.2 Predicted Noise Impacts

The following overview is based on the predicted impacts at the most affected receivers and is representative of the worst-case (15 minute) noise levels that are likely to occur during the discharge pipeline installation works. The predicted levels include consideration of the project specific mitigation and management measures outlined in Section 6.

The assessment shows the predicted impacts based on the exceedance of the management levels, as per the categories in Table 4.

No cumulative impacts from other major works around Parramatta, such as the Parramatta Light Rail are expected due to the vicinity of the discharge pipeline installation works to other major projects.

Table 4: Summary of NML exceedance ranges

Impact class	Predicted noise level
Noticable	0 <= 10 dB above NML
Clearly Audible	10 <= 20 dB above NML
Moderately Intrusive	20 <= 30 dB above NML
Highly Intrusive	> 30 dB above NML

A summary of the number of receivers where NML exceedances are predicted for the various work activities is shown in the following respective subsections. Table 5 provides a summary of the results detailed in the twelve (12) CNVISs. The CNVISs assess the number of receivers as individual levels of buildings potentially being impacted. Further consultation was undertaken with residential properties which have predicted impacts of Clearly Audible, Moderately Intrusive and Highly Intrusive to determine the number of units per potentially impacted level. The number of units have been summarised in Table 6. The assessment is generally considered conservative as the calculations assume all items of construction equipment are in use at the same time within individual scenarios. In reality, there would frequently be periods when construction noise levels are much lower than the worst-case levels predicted as well as times when no equipment is in use and no noise impacts occur.

Table 5: Overview of NML exceedances

Receiver Category	Exceedance Category	Number of Receivers With NML Exceedance																	
		1A	1B		1C	2A	2B		2C	3A	3B		3C		4A	4B		4C	
		E	E	N	EN	E	E	N	EN	E	E	N	E	N	E	E	N	E	N
Residential	1-10dB	-	-	84	-	-	-	62	-	22	19	45	-	27	50	37	61	28	34
	11-20dB	-	-	-	-	-	-	-	-	-	-	19	-	-	18	21	37	24	28
	21-30dB	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	21	-	24
	>30dB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
	SD[1]	-	-	48	-	-	-	44	-	-	-	56	-	17	-	-	86	-	85
	SD[2]	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	64	-	56
Other sensitive	1-10dB	3	1	1	-	21	21	21	-	17	17	17	-	-	17	17	17	13	13
	11-20dB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	21-30dB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>30dB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Commercial	1-10 dB	53	32	32	14	76	71	71	27	104	67	67	25	25	54	43	43	40	40
	11-20dB	12	12	12		25	20	20	-	26	18	18	-	-	19	15	15	5	5
	21-30dB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>30dB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	HNA	25	19	19	5	60	45	45	8	55	36	36	5	5	41	34	34	22	22

Notes: E = Evening hours, N = Night-time hours, HNA = Highly Noise Affected, SD = Sleep Disturbance, SD1 = Potentially Sleep Disturbed (exceed RBL + 15 screening criterion), SD2 = Exceed 65 dBA awakening criterion.

Table 6: Number of units per level of residential buildings with predicted impacts of Clearly Audible, Moderately Intrusive and Highly Intrusive.

Building Address	Level(s) impacted	Predicted impact	Number of receivers/units (total)
30 Charles Street, Parramatta	1,2 & 3	Highly Intrusive	51
30 Charles Street, Parramatta	4 to 14	Moderately	101
22 Charles Street, Parramatta	1 to 10	Moderately Intrusive	84
SE 3 Level 2 96 Philip Street, Parramatta	9 & 10	Clearly Audible	Commercial building. Ground floor tenants (restaurant) operates at night.
109-113 George Street, Parramatta	4 to 6	Clearly Audible	54
109-113 George Street, Parramatta	7 to 22	Clearly Audible	182
SE 2 Level 2 107 George Street, Parramatta	1 to 4	Clearly Audible	Commercial building. Operates until 9pm.
6-10 Charles Street, Parramatta	11,12, 14, & 15	Clearly Audible	25
SE 1 Level 2 20 Charles Street, Parramatta	1 to 10	Clearly Audible	Commercial. Police on Level 4 are the only tenants using the property at night.

The assessment of the predicted worst-case noise levels during the discharge pipeline installation works, indicated in Table 5 and Table 6, shows:

- Noise impacts are expected during the discharge pipeline installation works. Works are predicted to result in NML exceedances at nearby residential, 'other sensitive', and commercial receivers.
- 'Other sensitive' receivers include educational institutions and Places of worship. Considering the works will only be taking place during evening and night-time hours these 'other sensitive' receivers are not expected to be impacted.
- Three (3) buildings have been assessed by KNOWnoise^{TM} as residential buildings, however following consultation they were determined to be commercial buildings which operate past 5pm.
- Apart from the aforementioned three (3) buildings, commercial receivers are not expected to be impacted due to works taking place OOH.
- The highest impact at nearby residential receivers occurs during the NDD and Pavement Removal taking place at Section 4 (the final section of the works) in which noise levels are predicted to exceed the NML with a high impact rating (i.e., >30dB above the NML) at three (3) receivers.
- L_{AFmax} noise levels have the potential to exceed the sleep disturbance screening level at a number of residential receivers during work stages 1B, 2B, 3B, 3C, 4B, and 4C. Best-practise construction management should be implemented to reduce L_{AFmax} as far as practicable.
- L_{AFmax} noise levels additionally have the potential to exceed the awakening criterion at a number of residential receivers during work stages 3B, 4B, and 4C. Best-practise construction management should be implemented to reduce L_{AFmax} as far as practicable.

Recommended noise mitigation and management measures are discussed in **Section 6.**

5 CONSTRUCTION VIBRATION

The minimum working distances for typical vibration intensive construction equipment are provided in the TfNSW CNVS and are shown in Table 7. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from AVTG). They are calculated from empirical data which suggests that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 7: Recommended minimum working distance from vibration intensive equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	25 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

The equipment necessary for the installation of the Parramatta discharge pipeline does not involve any typical vibration intensive construction equipment as indicated in Table 7. Furthermore, the vibration limits for safe working distances for the equipment required for the discharge pipeline installation works would be less than a hand-held jackhammer which is 2m for the human comfort trigger. The works will be taking place further than 2m from any commercial, residential and/or heritage buildings and therefore vibration impacts are not predicted for the discharge pipeline installation works.

6 MITIGATION AND MANAGEMENT MEASURES

6.1 Applicable Mitigation Measures

The overall objective of construction noise and vibration management is to limit impacts on nearby receivers. This can be achieved by implementing the standard mitigation and management measures outlined in the Project's DNVIS as well as implementing the discharge pipeline installation work's specific mitigation and management measures.

Noise impacts may be apparent at the nearest receivers at certain times during the discharge pipeline installation works. GLC should apply all feasible and reasonable mitigation measures to minimise the impacts, particularly during highly noise intensive work, such as concrete sawing.

The following measures shown in Table 8 must be implemented in accordance with the CNVMP, Project EPL (updated to include discharge route) and CoA D39 to minimise the potential impacts from the works. Reference to applicable CoA and Revised Environmental Mitigation Measures (REMMs) are provided for each of these measures.

Table 8: Applicable Mitigation and Management Measures

ID	Measure	Reference/Notes
NV01	The use of noise intensive equipment (i.e., saw cutting) would be undertaken as early as possible in each work shift, to reduce impacts on the community during the night.	REMM NV04
NV02	Carry out community consultation to determine the need and frequency of respite periods, as required by the CoA.	CoA D51 REMM NV01, NV15
NV03	Training should be provided to project personnel, including relevant sub-contractors, on noise and vibration requirements and the location of sensitive receivers during inductions and toolbox talks.	CoA D42, Best Practice
NV04	Truck drivers should avoid compression braking as far as practicable.	CoA D42, Best Practice
NV05	Trucks should not idle near to residential receivers.	CoA D42, Best Practice
NV06	Portable noise barriers (i.e., noise blankets) will be used around particularly noisy equipment such as concrete saws, where deemed necessary.	CoA D42, REMM NV02 Best Practice
NV07	Plant and machinery should be fitted with manufacturer supplied noise suppression devices and maintained where required.	CoA D42, REMM NV02
NV08	Power tools should use mains power where possible rather than generators.	CoA D42, Best Practice
NV09	Shut down machinery, including generators, when not in operation.	CoA D42, Best Practice

NV10	Ensure equipment is operated in the correct manner.	CoA D42, Best Practice
NV11	All equipment should be appropriately maintained and fitted with noise control devices, where practicable (e.g., attenuated generators).	CoA D42, Best Practice
NV12	Where night-time works are required, equipment/trucks should use broadband reversing alarms.	CoA D42, Best Practice
NV13	Engagement and consultation should be carried out with the affected communities to understand their preferences for mitigation and management measures.	CoA D38, D41, D51 REMM NV01, NV15
NV14	Provide appropriate notice to the affected sensitive receivers prior to starting works and before any noisy periods of works.	CoA D38, D51
NV15	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.	CoA D45
NV16	Where there are complaints regarding noise, review and implement additional control measures, where feasible and reasonable.	CoA B4, D42, Best Practice
NV17	Conduct noise and/or vibration monitoring in response to any formal complaints received.	CoA B4, D42, Best Practice
NV18	Noise monitoring should be undertaken where NMLs are predicted to be exceeded as defined by the AMM outlined in Section 8.3.	CoA D42, Best Practice
NV19	Spoil, broken pavement, and asphalt waste will be loaded, as quietly as practicable, directly onto trucks to avoid double handling. Further measures that might be considered include: • not shaking the excavator bucket that is used for material removal, • lining the truck tray to dampen noise from dropping of the first loads, • gently placing the first loads in the truck tray.	Best practice
NV20	Battery powered lights will be used, if practicable.	CoA D42
NV21	Metal on metal clashes will be avoided.	Best practice
NV22	Excavators fitted with rubber tracks will be used, if practicable.	CoA D42
NV23	During equipment and plant selection, the quietest available plant and equipment will be chosen for the works, where reasonable and feasible.	Best practice

NV24	As works will be taking place in stages, attended noise monitoring will be conducted at earlier stages (which have a lower predicted impacts compared to later stages) to verify predictions. Based on the monitoring results, further mitigation measures will be implemented for further stages as required.	Best practice

6.1.1 Results of Consultation

In accordance with CoA D43 and D44, the DNVIS must include specific mitigation measures identified through consultation with affected sensitive land users.

Community consultation has been undertaken in accordance with the Community Communication Strategy (CCS). To date no additional mitigation and management measures were identified through consultation with potentially affected sensitive land users. Relevant parties will be contacted again closer to the works commencing with updates on duration and timing of works, as requested. The results from consultation with affected sensitive land users can be found in Attachment 14.

Furthermore, consultation has been conducted with the City of Parramatta Council and approval has been received for the works to take place.

6.2 Additional Mitigation Measures

Where the predicted 'mitigated' construction noise levels are above the project specific noise management levels (NMLs), the Additional Mitigation Measures (AMM) identified in the Sydney Metro CNVS are to be implemented. The AMM for ground-borne noise and construction vibration are also applicable where predictions are above the relevant management levels. The approach, guided by the AMM, is primarily aimed at pro-active engagement with affected sensitive receivers rather than additional noise reducing mitigation. The AMM applies to all receiver types where these receivers are in-use.

The types of additional mitigation measures are listed in Table 9 and described in the Sydney Metro CNVS. The AMM for construction noise is identified in Table 10. The AMM for ground-borne noise and vibration are identified in Table 11.

Table 9: Additional Mitigation Measures

Mitigation / Management Measure	Abbreviation
Alternative accommodation	AA
Monitoring	M
Individual briefings	IB
Letter box drops	LB
Project-specific respite offer	RO
Phone calls and emails	PC
Specific notification	SN

Table 10: Additional Mitigation Measures Matrix – Construction Noise

Time Period		Mitigation Measures Predicted $L_{Aeq(15minute)}$ noise level above NML			
		0 to 10 dBA	11 to 20 dBA	21 to 30 dBA	> 30 dBA
Approved Hours	Mon-Fri (7am – 6pm)	-	LB	LB, M, SN	LB, M, SN
	Sat (8am – 6pm)				
	Sun/Pub Hol (Nil)				
OOHW (Evening)	Mon-Fri (6pm – 10pm)	LB	LB, M	LB, M, SN, RO	LB, M, SN, IB, PC, RO
	Sat (6pm – 10pm)				
	Sun/Pub Hol (8am -6pm)				
OOHW (Night)	Mon-Fri (10pm – 7am)	LB	LB, M, SN, RO	LB, M, SN, IB, PC, RO, AA	LB, M, SN, IB, PC, RO, AA
	Sat (10pm – 8am)				
	Sun/Pub Hol (6pm -7am)				

Table 11: Additional Mitigation Measures Matrix – Ground-borne Vibration

Time Period		Mitigation Measures Predicted vibration level above maximum level (human comfort)
Approved Hours	Mon-Fri (7am – 6pm)	LB, M, RO
	Sat (8am – 6pm)	
	Sun/Pub Hol (Nil)	
OOHW (Evening)	Mon-Fri (6pm – 10pm)	LB, M, IB, PC, RO, SN
	Sat (6pm – 10pm)	
	Sun/Pub Hol (8am -6pm)	
OOHW (Night)	Mon-Fri (10pm – 7am)	LB, M, IB, PC, RO, SN, AA
	Sat (10pm – 8am)	
	Sun/Pub Hol (6pm -7am)	

6.3 Noise and Vibration Monitoring

Noise and vibration for the Sydney Metro WTP will be managed in accordance with the Noise and Vibration Monitoring Program – Sydney Metro West Western Tunnelling Package (NVMoP).

In accordance with MCoA C14, a noise monitoring program has been designed to include noise monitoring at sensitive receivers during critical periods of high-risk noise events.

Attended noise and vibration monitoring will be undertaken at locations representative of the nearest and potentially most affected receivers, where practicable. As per MCoA C16 real time monitoring data will be readily available to the construction team, Sydney Metro, the ER and the AA. Monitoring data will also be made available to the Planning Secretary and EPA on request.

To verify predicted noise levels are in accordance with those modelled, attended noise monitoring will be conducted at noise sensitive receivers, where practicable, during OOHWs where the monitoring has been identified as an "additional mitigation measure". Monitoring locations will be outlined in a noise monitoring plan developed to cover the specific works and included with the OOHW protocol for the works. Monitoring will also be undertaken in the event of a complaint being received.

Monitoring may furthermore be conducted to:

- confirm the sound power levels of plant and activities assumed in the CNVISs,
- evaluate the performance of any mitigation measures (e.g., noise blankets).

7 CONCLUSION

This DNVIS has been prepared to accompany the Project-wide DNVIS and CNVMP, and to comply with MCoA D43 and D44.

Consistent with other major infrastructure projects in suburban/urban areas, noise and vibration impacts during construction are inevitable as works require the use of noise and vibration intensive equipment in proximity to sensitive receivers.

The airborne noise impact assessment finds that noticeable to highly intrusive impacts are predicted to residential receivers and noticeable impacts are predicted to 'other sensitive' receivers including educational institutions and places of worship. However, considering works will only be taking place out of standard construction hours it is not expected that 'other sensitive' receivers will be impacted. Furthermore, commercial receivers have not been considered in this assessment due to the works taking place OOH and no impacts are predicted.

Sleep disturbance impacts and vibration impacts during the discharge pipeline installations works have not been predicted. Nevertheless, best-practice construction management will be implemented to reduce L_{AFmax} noise events and vibrations levels as far as practicable.

Based on the outcomes of the assessment, best-practice mitigation and management measures should be applied, where feasible and reasonable, to control and minimise the impacts during construction as far as reasonably practicable in accordance with the CNVMP and the CNVS.

ATTACHMENTS

Attachment 1 – Requirements Matrix

ID No.	Requirements	Reference
Ministers Conditions of Approval (MCoA)		
D35	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Monday to Fridays; and	Project-wide DNVIS (Section 1.1.5)
	(b) 8:00am to 6:00pm Saturdays; and	
	(c) at no time on Sundays or Public Holidays.	
D39	All reasonable and feasible mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: (a) Construction "Noise Affected" noise management levels established using the ICNG (DECC, 2009)	Section 2.1, Project-wide DNVIS (Section 3.2).
	(b) Vibration criteria established using the *Assessing Vibration: A Technical Guideline* (DEC, 2006) for human exposure	Project-wide DNVIS (Section 3.5)
	(c) Australian Standard AS 2187.2: 2006 "Explosives – Storage and Use – Use of Explosives" (for human exposure)	Not applicable – blasting not part of Project design
	(d) BS 7385 Part 2-1993 'Evaluation and measurement for vibration in Buildings – Part 2" as they are applicable to Australian conditions; and	Project-wide DNVIS (Section 3.5)
	(e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – Effects of Vibration on Structures (for structural damage for structurally unsound heritage items.	Project-wide DNVIS (Section 3.5)
	Any work identified as exceeding the NMLs and/or vibration criteria must be managed in accordance with the Project NVMP. Note that the ICNG identifies "particularly annoying: activities that require the addition of 5dB(A) to the predicted level before comparing to the construction NML.	Section 5
D41	Noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institution are made at no cost to the affected institution.	N/A works are not predicted to impact 'other sensitive' receivers, Section 3.2

ID No.	Requirements	Reference
D42	Industry best practice construction methods must be implemented where reasonably practicable to ensure that noise levels are minimised around sensitive land user(s). Practices must include, but are not limited to: (a) use of regularly serviced low sound power equipment;	Section 5.1
	(b) temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities such as rock hammering and concrete cutting; and	Section 5.1
	(c) use of alternative construction and demolition techniques.	Section 5.1
D43	Detailed Noise and Vibration Impact Statements (DNVIS) must be prepared for any work that may exceed NMLs, vibration criteria and/or ground borne noise levels specified in Conditions D39 and D40 of this schedule at any residence outside of construction hours identified in Condition D35 of this schedule, or where receivers will be highly noise affected. The DNVIS will include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the DNVIS must be provided to the AA and ER before the commencement of the associated works. The Planning Secretary and the EPA may request a copy(ies) of the DNVIS.	This document Section 1 Section 5 Attachment 1
D44	DNVIS must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive land users.	This document
D45	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Noise and Vibration CEMP Sub-plan.	Section 5.1
D46	Vibration testing must be conducted during vibration generating activities that have the potential to impact on Heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures. Such measures must include, but not be limited to, review or modification of excavation techniques	N/A no heritage items will be impacted by the works

ID No.	Requirements	Reference
D49	If a heritage item is found to be structurally unsound (following inspection) a more conservative cosmetic damage criterion of 2.5 mm/s peak component particle velocity (from DIN 4150) must be applied	N/A no heritage items will be impacted by the works
D63	Appropriate equipment to monitor areas in proximity of construction sites and the tunnel route during construction must be installed with particular reference to at risk buildings, structures and utilities identified in the condition surveys required by Condition D60 of this schedule and / or geotechnical analysis as required. If monitoring during construction indicate exceedance of the vibration criteria identified in the DNVIS prepared under Condition D43 of this schedule, then all construction affecting settlement must cease immediately and must not resume until fully rectified or a revised method of construction is established that will ensure protection of affected buildings.	N/A works are not predicted to cause settlement.
Sydney Metro – Construction Environmental Management Framework (CEMF)		
8.2 (b)	Detailed Construction Noise and Vibration Impact statements will be prepared for noise-intensive construction sites and or activities, to ensure the adequacy of the noise and vibration mitigation measures. Specifically, construction Noise and Vibration Impact Statements will be prepared for works proposed to be undertaken outside of standard construction hours and to support applications to undertake out of hours works (this includes variations of EPL's and applications to relevant agencies).	This document
Sydney Metro – Construction Noise and Vibration Standard (CNVS)		
3.1	Detailed Noise & Vibration Impact Statements (DNVIS) • Identify sensitive receivers	Section 3.2, Section 4
	• Determine background noise levels	Project-wide DNVIS (Section 2.3)
	• Determine noise and vibration management levels	Section 2
	• Determine source noise levels and construction scenarios	Section 3
	• Identify mitigation and measures	Section 5
	• Classify impacts	Section 3

ID No.	Requirements	Reference
4	Standard Noise and Vibration Measures For all Sydney Metro construction projects, the standard mitigation measures in Table 11 (of the CNVS) shall be applied by default where feasible and reasonable in order to minimise the potential noise and vibration impacts at the surrounding noise sensitive receivers.	Section 5, Project-wide DNVIS (Section 8.1)
9	Documentation Requirements • Acoustic terminology/glossary	Terms & Definitions
	• Overview of the Project/Works	Section 1
	• Secretary's Environmental Assessment Requirements	Attachment 1
	• Site Plan and Sensitive Receivers	Section 2, Section 3
	• Ambient Noise Monitoring	Project-wide DNVIS (Section 2.3)
	• Construction Noise and Vibration Assessment	Attachments 2-13
	• Summary of Noise and Vibration Impacts	Section 6
	• References	Within Document

Attachment 2 - Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 1A – Saw cutting (Section 1)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 87 dB(A) during the works, resulting in 25 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	87 dB(A)
Number of highly noise affected receivers (>75 dB)	25

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	56
Clearly Audible	10 <= 20 dB above NML	12
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	56
Clearly Audible	10 <= 20 dB above NML	12
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	56
Clearly Audible	10 <= 20 dB above NML	12

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	170
Clearly Audible	10 <= 20 dB above NML	12
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	40
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 3 - Stage 1 - Saw Cutting Pavement

Pipeline located below ground. Saw cutting will be required for the removal of the footpath and roadway pavement.
6/12/2023 8:00:47 PM - 9/1/2023 10:00:17 PM

Equipment	Quantity	Usage	Reduction	SWL
Concrete Saw (Std)*	1	30 %	3	111
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 111

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

GAMUDA Australia

LAING O'ROURKE

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747181	"235 CHURCH ST, PARRAMATTA"	3	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747180	"235 CHURCH ST, PARRAMATTA"	2	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747179	"235 CHURCH ST, PARRAMATTA"	1	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747178	"235 CHURCH ST, PARRAMATTA"	7	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747177	"235 CHURCH ST, PARRAMATTA"	6	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747176	"235 CHURCH ST, PARRAMATTA"	5	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747175	"235 CHURCH ST, PARRAMATTA"	4	RES	68	63	58	48			52	58		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745603	"52 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745602	"52 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745528	"140 CHURCH ST, PARRAMATTA"	29	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745520	"140 CHURCH ST, PARRAMATTA"	21	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745519	"140 CHURCH ST, PARRAMATTA"	20	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745518	"140 CHURCH ST, PARRAMATTA"	19	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745517	"140 CHURCH ST, PARRAMATTA"	18	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745516	"140 CHURCH ST, PARRAMATTA"	17	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745364	"330 CHURCH ST, PARRAMATTA"	61	RES	68	63	58	48	Y		55	61		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745363	"330 CHURCH ST, PARRAMATTA"	60	RES	68	63	58	48	Y		55	61		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745362	"330 CHURCH ST, PARRAMATTA"	59	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745361	"330 CHURCH ST, PARRAMATTA"	58	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745360	"330 CHURCH ST, PARRAMATTA"	57	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745359	"330 CHURCH ST, PARRAMATTA"	56	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745358	"330 CHURCH ST, PARRAMATTA"	55	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745357	"330 CHURCH ST, PARRAMATTA"	54	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745356	"330 CHURCH ST, PARRAMATTA"	53	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745355	"330 CHURCH ST, PARRAMATTA"	52	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745354	"330 CHURCH ST, PARRAMATTA"	51	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745353	"330 CHURCH ST, PARRAMATTA"	50	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745352	"330 CHURCH ST, PARRAMATTA"	49	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745351	"330 CHURCH ST, PARRAMATTA"	48	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745350	"330 CHURCH ST, PARRAMATTA"	47	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745349	"330 CHURCH ST, PARRAMATTA"	46	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745348	"330 CHURCH ST, PARRAMATTA"	45	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745347	"330 CHURCH ST, PARRAMATTA"	44	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable

NCA03	745346	"330 CHURCH ST, PARRAMATTA"	43	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745345	"330 CHURCH ST, PARRAMATTA"	42	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745344	"330 CHURCH ST, PARRAMATTA"	41	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745343	"330 CHURCH ST, PARRAMATTA"	40	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745342	"330 CHURCH ST, PARRAMATTA"	39	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745341	"330 CHURCH ST, PARRAMATTA"	38	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745340	"330 CHURCH ST, PARRAMATTA"	37	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745339	"330 CHURCH ST, PARRAMATTA"	36	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745338	"330 CHURCH ST, PARRAMATTA"	35	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745337	"330 CHURCH ST, PARRAMATTA"	34	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745336	"330 CHURCH ST, PARRAMATTA"	33	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745335	"330 CHURCH ST, PARRAMATTA"	32	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745334	"330 CHURCH ST, PARRAMATTA"	31	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745333	"330 CHURCH ST, PARRAMATTA"	30	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745332	"330 CHURCH ST, PARRAMATTA"	29	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745331	"330 CHURCH ST, PARRAMATTA"	28	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745330	"330 CHURCH ST, PARRAMATTA"	27	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745329	"330 CHURCH ST, PARRAMATTA"	26	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	745328	"330 CHURCH ST, PARRAMATTA"	25	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	745327	"330 CHURCH ST, PARRAMATTA"	24	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745326	"330 CHURCH ST, PARRAMATTA"	23	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745325	"330 CHURCH ST, PARRAMATTA"	22	RES	68	63	58	48			52	58		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745324	"330 CHURCH ST, PARRAMATTA"	21	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745323	"330 CHURCH ST, PARRAMATTA"	20	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745322	"330 CHURCH ST, PARRAMATTA"	19	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745321	"330 CHURCH ST, PARRAMATTA"	18	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745320	"330 CHURCH ST, PARRAMATTA"	17	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745319	"330 CHURCH ST, PARRAMATTA"	16	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	2	COM	70	70	70	70			86	91	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	1	COM	70	70	70	70			87	92	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745115	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	9	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745114	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	8	COM	70	70	70	70			76	82	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745113	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	7	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745112	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	6	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	3	COM	70	70	70	70			83	89	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745102	"45 MACQUARIE ST, PARRAMATTA"	34	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745101	"45 MACQUARIE ST, PARRAMATTA"	33	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745100	"45 MACQUARIE ST, PARRAMATTA"	32	RES	68	63	58	48			52	58		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745099	"45 MACQUARIE ST, PARRAMATTA"	31	RES	68	63	58	48			52	58		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745098	"45 MACQUARIE ST, PARRAMATTA"	30	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745097	"45 MACQUARIE ST, PARRAMATTA"	29	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745096	"45 MACQUARIE ST, PARRAMATTA"	28	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745095	"45 MACQUARIE ST, PARRAMATTA"	27	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745094	"45 MACQUARIE ST, PARRAMATTA"	26	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745093	"45 MACQUARIE ST, PARRAMATTA"	25	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745092	"45 MACQUARIE ST, PARRAMATTA"	24	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745091	"45 MACQUARIE ST, PARRAMATTA"	23	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745090	"45 MACQUARIE ST, PARRAMATTA"	22	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745089	"45 MACQUARIE ST, PARRAMATTA"	21	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745088	"45 MACQUARIE ST, PARRAMATTA"	20	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745087	"45 MACQUARIE ST, PARRAMATTA"	19	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745086	"45 MACQUARIE ST, PARRAMATTA"	18	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745065	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	10	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745064	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	9	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745063	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	8	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745062	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	7	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745061	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	6	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745060	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	5	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745059	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	4	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744973	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	3	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744972	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	2	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744970	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	11	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744969	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	10	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744968	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	9	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744967	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	8	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744966	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	7	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744965	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	6	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744964	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	5	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744963	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	4	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable

NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744761	"119 MACQUARIE ST, PARRAMATTA"	2	PoW	55	55	55	55			56	61		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744760	"119 MACQUARIE ST, PARRAMATTA"	1	PoW	55	55	55	55			55	60		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744691	"48 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744690	"48 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744689	"48 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744688	"48 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744687	"48 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744686	"48 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744680	"244 CHURCH ST, PARRAMATTA"	1	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	88	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744530	"SE 1 LEVEL 7 1 HORWOOD PL, PARRAMATTA"	10	COM	65	65	65	65			66	71		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable

NCA03	744529	"SE 1 LEVEL 7 1 HORWOOD PL, PARRAMATTA"	9	COM	65	65	65	65			66	71		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744528	"SE 1 LEVEL 7 1 HORWOOD PL, PARRAMATTA"	8	COM	65	65	65	65			65	71		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744527	"SE 1 LEVEL 7 1 HORWOOD PL, PARRAMATTA"	7	COM	65	65	65	65			65	70		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744506	"2 HORWOOD PL, PARRAMATTA"	4	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744505	"2 HORWOOD PL, PARRAMATTA"	3	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744504	"2 HORWOOD PL, PARRAMATTA"	2	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744503	"2 HORWOOD PL, PARRAMATTA"	1	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744447	"1 SORRELL ST, PARRAMATTA"	14	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744446	"1 SORRELL ST, PARRAMATTA"	13	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744445	"1 SORRELL ST, PARRAMATTA"	12	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744444	"1 SORRELL ST, PARRAMATTA"	11	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744443	"1 SORRELL ST, PARRAMATTA"	10	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744442	"1 SORRELL ST, PARRAMATTA"	9	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744441	"1 SORRELL ST, PARRAMATTA"	8	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744440	"1 SORRELL ST, PARRAMATTA"	7	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744439	"1 SORRELL ST, PARRAMATTA"	6	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744438	"1 SORRELL ST, PARRAMATTA"	5	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744437	"1 SORRELL ST, PARRAMATTA"	4	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744436	"1 SORRELL ST, PARRAMATTA"	3	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744435	"1 SORRELL ST, PARRAMATTA"	2	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744434	"1 SORRELL ST, PARRAMATTA"	1	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744210	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744209	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744208	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	80		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744207	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744206	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744205	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744204	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744203	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	744202	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	744201	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744200	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			83	89	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744199	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			85	90	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744198	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			87	92	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744197	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744104	"THE ROXY ARCADE 73 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			87	92	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

NCA03	744065	"LEVEL 3 3 HORWOOD PL, PARRAMATTA"	8	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744064	"LEVEL 3 3 HORWOOD PL, PARRAMATTA"	7	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744063	"LEVEL 3 3 HORWOOD PL, PARRAMATTA"	6	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744062	"LEVEL 3 3 HORWOOD PL, PARRAMATTA"	5	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744061	"LEVEL 3 3 HORWOOD PL, PARRAMATTA"	4	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 3 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 1B – NDD and Pavement Removal (Section 1)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 86 dB(A) during the works, resulting in 19 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	86 dB(A)
Number of highly noise affected receivers (>75 dB)	19

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	33
Clearly Audible	10 <= 20 dB above NML	12
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	33
Clearly Audible	10 <= 20 dB above NML	12
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	33
Clearly Audible	10 <= 20 dB above NML	12

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	117
Clearly Audible	10 <= 20 dB above NML	12
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	48
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 3 - Stage 2 - NDD & Pavement Removal

NDD and removal of pavement is required to be lifted to allow for the discharge route piping.
6/12/2023 8:00:49 PM - 9/1/2023 5:00:38 AM

Equipment	Quantity	Usage	Reduction	SWL
Excavator (06 tonne)	1	40 %	0	90
Tipper Truck	1	30 %	0	93
Vacc truck	1	50 %	0	109
Bogies	1	30 %	0	95
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 109

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747181	"235 CHURCH ST, PARRAMATTA"	3	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747180	"235 CHURCH ST, PARRAMATTA"	2	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747179	"235 CHURCH ST, PARRAMATTA"	1	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	747178	"235 CHURCH ST, PARRAMATTA"	7	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747177	"235 CHURCH ST, PARRAMATTA"	6	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747176	"235 CHURCH ST, PARRAMATTA"	5	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747175	"235 CHURCH ST, PARRAMATTA"	4	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745603	"52 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745602	"52 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745364	"330 CHURCH ST, PARRAMATTA"	61	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745363	"330 CHURCH ST, PARRAMATTA"	60	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745362	"330 CHURCH ST, PARRAMATTA"	59	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745361	"330 CHURCH ST, PARRAMATTA"	58	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745360	"330 CHURCH ST, PARRAMATTA"	57	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745359	"330 CHURCH ST, PARRAMATTA"	56	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745358	"330 CHURCH ST, PARRAMATTA"	55	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745357	"330 CHURCH ST, PARRAMATTA"	54	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745356	"330 CHURCH ST, PARRAMATTA"	53	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745355	"330 CHURCH ST, PARRAMATTA"	52	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745354	"330 CHURCH ST, PARRAMATTA"	51	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745353	"330 CHURCH ST, PARRAMATTA"	50	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745352	"330 CHURCH ST, PARRAMATTA"	49	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745351	"330 CHURCH ST, PARRAMATTA"	48	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745350	"330 CHURCH ST, PARRAMATTA"	47	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745349	"330 CHURCH ST, PARRAMATTA"	46	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745348	"330 CHURCH ST, PARRAMATTA"	45	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745347	"330 CHURCH ST, PARRAMATTA"	44	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745346	"330 CHURCH ST, PARRAMATTA"	43	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745345	"330 CHURCH ST, PARRAMATTA"	42	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745344	"330 CHURCH ST, PARRAMATTA"	41	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745343	"330 CHURCH ST, PARRAMATTA"	40	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745342	"330 CHURCH ST, PARRAMATTA"	39	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745341	"330 CHURCH ST, PARRAMATTA"	38	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable

NCA03	745340	"330 CHURCH ST, PARRAMATTA"	37	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745339	"330 CHURCH ST, PARRAMATTA"	36	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745338	"330 CHURCH ST, PARRAMATTA"	35	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745337	"330 CHURCH ST, PARRAMATTA"	34	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745336	"330 CHURCH ST, PARRAMATTA"	33	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745335	"330 CHURCH ST, PARRAMATTA"	32	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745334	"330 CHURCH ST, PARRAMATTA"	31	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745333	"330 CHURCH ST, PARRAMATTA"	30	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745332	"330 CHURCH ST, PARRAMATTA"	29	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745331	"330 CHURCH ST, PARRAMATTA"	28	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745330	"330 CHURCH ST, PARRAMATTA"	27	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745329	"330 CHURCH ST, PARRAMATTA"	26	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	745328	"330 CHURCH ST, PARRAMATTA"	25	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745327	"330 CHURCH ST, PARRAMATTA"	24	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745326	"330 CHURCH ST, PARRAMATTA"	23	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745325	"330 CHURCH ST, PARRAMATTA"	22	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745324	"330 CHURCH ST, PARRAMATTA"	21	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745323	"330 CHURCH ST, PARRAMATTA"	20	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745322	"330 CHURCH ST, PARRAMATTA"	19	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745321	"330 CHURCH ST, PARRAMATTA"	18	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745320	"330 CHURCH ST, PARRAMATTA"	17	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	2	COM	70	70	70	70			84	92	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	1	COM	70	70	70	70			86	93	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745115	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	9	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745114	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	8	COM	70	70	70	70			75	83		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745113	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	7	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745112	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	6	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	5	COM	70	70	70	70			78	86	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	4	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	3	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745102	"45 MACQUARIE ST, PARRAMATTA"	34	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745101	"45 MACQUARIE ST, PARRAMATTA"	33	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745100	"45 MACQUARIE ST, PARRAMATTA"	32	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745099	"45 MACQUARIE ST, PARRAMATTA"	31	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745098	"45 MACQUARIE ST, PARRAMATTA"	30	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745097	"45 MACQUARIE ST, PARRAMATTA"	29	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable

NCA03	745096	"45 MACQUARIE ST, PARRAMATTA"	28	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745095	"45 MACQUARIE ST, PARRAMATTA"	27	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745094	"45 MACQUARIE ST, PARRAMATTA"	26	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745093	"45 MACQUARIE ST, PARRAMATTA"	25	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745092	"45 MACQUARIE ST, PARRAMATTA"	24	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745091	"45 MACQUARIE ST, PARRAMATTA"	23	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744968	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	9	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744967	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	8	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744966	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	7	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744965	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	6	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744964	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744963	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	4	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744691	"48 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744689	"48 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744688	"48 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744687	"48 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable

NCA03	744686	"48 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744680	"244 CHURCH ST, PARRAMATTA"	1	EDU	55	55	55	55			59	67		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			82	89	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			82	89	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744506	"2 HORWOOD PL, PARRAMATTA"	4	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744505	"2 HORWOOD PL, PARRAMATTA"	3	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744504	"2 HORWOOD PL, PARRAMATTA"	2	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744503	"2 HORWOOD PL, PARRAMATTA"	1	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744210	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744209	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744208	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744207	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744206	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744205	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744204	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744203	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744202	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	744201	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744200	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744199	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			84	91	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744198	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			85	93	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744197	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744104	"THE ROXY ARCADE 73 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			86	93	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 4 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 1C – Installation of pipeline and pavement reinstatement (Section 1)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 78 dB(A) during the works, resulting in 5 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	78 dB(A)
Number of highly noise affected receivers (>75 dB)	5

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	14
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	14
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	14
Clearly Audible	10 <= 20 dB above NML	0

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	14
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	0
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	14
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 3 - Stage 3 - Installation of Pipeline & Reinstatement of Surface

Installation of pipeline, backfill excavations, compact and reinstate surface with asphalt.
6/12/2023 8:00:03 PM - 9/1/2023 5:00:33 AM

Equipment	Quantity	Usage	Reduction	SWL
Bogies	1	30 %	0	95
Plate compactor (small e.g. 60kg)	1	30 %	0	99
Tipper Truck	1	30 %	0	93
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 102

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	2	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	1	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	4	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	3	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744202	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744201	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744200	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744199	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744198	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744104	"THE ROXY ARCADE 73 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744202	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744201	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744200	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744199	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744198	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744104	"THE ROXY ARCADE 73 GEORGE ST, PARRAMATTA"	COM	Human Comfort

Attachment 5 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 2A – Saw cutting (Section 2)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 89 dB(A) during the works, resulting in 60 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	89 dB(A)
Number of highly noise affected receivers (>75 dB)	60

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	97
Clearly Audible	10 <= 20 dB above NML	25
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	97
Clearly Audible	10 <= 20 dB above NML	25
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	97
Clearly Audible	10 <= 20 dB above NML	25

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	181
Clearly Audible	10 <= 20 dB above NML	25
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	32
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 4 - Stage 1 - Saw Cutting Pavement

Pipeline located below ground. Saw cutting will be required for the removal of the footpath and roadway pavement.
6/12/2023 8:00:18 PM - 9/1/2023 10:00:42 PM

Equipment	Quantity	Usage	Reduction	SWL
Concrete Saw (Std)*	1	30 %	3	111
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 111

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747181	"235 CHURCH ST, PARRAMATTA"	3	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747180	"235 CHURCH ST, PARRAMATTA"	2	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747179	"235 CHURCH ST, PARRAMATTA"	1	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747178	"235 CHURCH ST, PARRAMATTA"	7	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747177	"235 CHURCH ST, PARRAMATTA"	6	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	747176	"235 CHURCH ST, PARRAMATTA"	5	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	747175	"235 CHURCH ST, PARRAMATTA"	4	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747083	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	21	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747082	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	20	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747081	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	19	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747080	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	18	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747079	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	17	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747078	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			72	78		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747077	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747076	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747075	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			73	79		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747074	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747073	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747072	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747071	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747070	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	747069	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	747068	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	747067	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	747066	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			81	87	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	747065	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	747064	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			84	90	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	747063	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			85	90	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	5	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	4	COM	70	70	70	70			80	86	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	3	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	2	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	1	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

NCA03	746252	"169 MACQUARIE ST, PARRAMATTA"	21	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746251	"169 MACQUARIE ST, PARRAMATTA"	20	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746250	"169 MACQUARIE ST, PARRAMATTA"	19	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746249	"169 MACQUARIE ST, PARRAMATTA"	18	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746248	"169 MACQUARIE ST, PARRAMATTA"	17	EDU	55	55	55	55			62	67		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746247	"169 MACQUARIE ST, PARRAMATTA"	16	EDU	55	55	55	55			62	67		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746246	"169 MACQUARIE ST, PARRAMATTA"	15	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746245	"169 MACQUARIE ST, PARRAMATTA"	14	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746244	"169 MACQUARIE ST, PARRAMATTA"	13	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746243	"169 MACQUARIE ST, PARRAMATTA"	12	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746242	"169 MACQUARIE ST, PARRAMATTA"	11	EDU	55	55	55	55			60	66		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746241	"169 MACQUARIE ST, PARRAMATTA"	10	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746240	"169 MACQUARIE ST, PARRAMATTA"	9	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746239	"169 MACQUARIE ST, PARRAMATTA"	8	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746238	"169 MACQUARIE ST, PARRAMATTA"	7	EDU	55	55	55	55			59	64		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746237	"169 MACQUARIE ST, PARRAMATTA"	6	EDU	55	55	55	55			59	64		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746236	"169 MACQUARIE ST, PARRAMATTA"	5	EDU	55	55	55	55			59	64		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746235	"169 MACQUARIE ST, PARRAMATTA"	4	EDU	55	55	55	55			58	64		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746234	"169 MACQUARIE ST, PARRAMATTA"	3	EDU	55	55	55	55			58	63		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746233	"169 MACQUARIE ST, PARRAMATTA"	2	EDU	55	55	55	55			58	63		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746232	"169 MACQUARIE ST, PARRAMATTA"	1	EDU	55	55	55	55			58	63		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746204	"14 LAMONT ST, PARRAMATTA"	5	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746203	"14 LAMONT ST, PARRAMATTA"	4	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746202	"14 LAMONT ST, PARRAMATTA"	3	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746201	"14 LAMONT ST, PARRAMATTA"	2	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746200	"14 LAMONT ST, PARRAMATTA"	1	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746085	"76 PHILLIP ST, PARRAMATTA"	6	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746084	"76 PHILLIP ST, PARRAMATTA"	5	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746047	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			73	79		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746046	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746045	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746044	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746043	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	80	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746042	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746041	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			76	82	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746040	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable

NCA03	746039	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746038	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746037	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746036	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745631	"SE 1 LEVEL 1 100 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745630	"SE 1 LEVEL 1 100 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745435	"8 SORRELL ST, PARRAMATTA"	3	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745434	"8 SORRELL ST, PARRAMATTA"	2	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745433	"8 SORRELL ST, PARRAMATTA"	1	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745364	"330 CHURCH ST, PARRAMATTA"	61	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745363	"330 CHURCH ST, PARRAMATTA"	60	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745362	"330 CHURCH ST, PARRAMATTA"	59	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745361	"330 CHURCH ST, PARRAMATTA"	58	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745360	"330 CHURCH ST, PARRAMATTA"	57	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745359	"330 CHURCH ST, PARRAMATTA"	56	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745358	"330 CHURCH ST, PARRAMATTA"	55	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745357	"330 CHURCH ST, PARRAMATTA"	54	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745356	"330 CHURCH ST, PARRAMATTA"	53	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745355	"330 CHURCH ST, PARRAMATTA"	52	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745354	"330 CHURCH ST, PARRAMATTA"	51	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745353	"330 CHURCH ST, PARRAMATTA"	50	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745352	"330 CHURCH ST, PARRAMATTA"	49	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745351	"330 CHURCH ST, PARRAMATTA"	48	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745350	"330 CHURCH ST, PARRAMATTA"	47	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745349	"330 CHURCH ST, PARRAMATTA"	46	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745348	"330 CHURCH ST, PARRAMATTA"	45	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745347	"330 CHURCH ST, PARRAMATTA"	44	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	745346	"330 CHURCH ST, PARRAMATTA"	43	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745345	"330 CHURCH ST, PARRAMATTA"	42	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745344	"330 CHURCH ST, PARRAMATTA"	41	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745343	"330 CHURCH ST, PARRAMATTA"	40	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745342	"330 CHURCH ST, PARRAMATTA"	39	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745341	"330 CHURCH ST, PARRAMATTA"	38	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745340	"330 CHURCH ST, PARRAMATTA"	37	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745339	"330 CHURCH ST, PARRAMATTA"	36	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745338	"330 CHURCH ST, PARRAMATTA"	35	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable

NCA03	745337	"330 CHURCH ST, PARRAMATTA"	34	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745336	"330 CHURCH ST, PARRAMATTA"	33	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745335	"330 CHURCH ST, PARRAMATTA"	32	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745334	"330 CHURCH ST, PARRAMATTA"	31	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745333	"330 CHURCH ST, PARRAMATTA"	30	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745332	"330 CHURCH ST, PARRAMATTA"	29	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745331	"330 CHURCH ST, PARRAMATTA"	28	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745330	"330 CHURCH ST, PARRAMATTA"	27	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745250	"6 SORRELL ST, PARRAMATTA"	7	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745249	"6 SORRELL ST, PARRAMATTA"	6	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745248	"6 SORRELL ST, PARRAMATTA"	5	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745247	"6 SORRELL ST, PARRAMATTA"	4	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	2	COM	70	70	70	70			86	91	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	1	COM	70	70	70	70			87	92	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745115	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	9	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745114	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	8	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745113	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745112	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	3	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745068	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	13	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745067	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745066	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745065	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	10	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745064	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	9	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745063	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	8	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745062	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745061	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745060	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745059	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745058	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	3	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745057	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	2	COM	70	70	70	70			86	91	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745056	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	1	COM	70	70	70	70			88	93	Y	18	18	18	18	-	18	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745055	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	15	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745054	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	14	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable

NCA03	744970	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	11	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744969	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	10	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744968	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	9	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744967	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	8	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744966	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	7	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744965	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	6	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744964	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	5	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y		55	61		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y		54	60		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y		53	59		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48			52	58		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744889	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744888	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744887	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744886	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	81	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744885	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable

NCA03	744884	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744883	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			78	84	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744882	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	744881	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744880	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744879	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			86	91	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744878	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			88	93	Y	18	18	18	18	-	18	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			85	90	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			88	93	Y	18	18	18	18	-	18	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			89	95	Y	19	19	19	19	-	19	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744447	"1 SORRELL ST, PARRAMATTA"	14	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744446	"1 SORRELL ST, PARRAMATTA"	13	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744445	"1 SORRELL ST, PARRAMATTA"	12	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744444	"1 SORRELL ST, PARRAMATTA"	11	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744210	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744209	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744208	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744207	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744206	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744205	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	80	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744204	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744203	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744202	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744201	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744200	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744199	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744198	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744197	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744104	"THE ROXY ARCADE 73 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 6 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 2B – NDD and Pavement Removal (Section 2)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 86 dB(A) during the works, resulting in 45 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	86 dB(A)
Number of highly noise affected receivers (>75 dB)	45

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	92
Clearly Audible	10 <= 20 dB above NML	20
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	92
Clearly Audible	10 <= 20 dB above NML	20
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	92
Clearly Audible	10 <= 20 dB above NML	20

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	154
Clearly Audible	10 <= 20 dB above NML	20
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	44
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 4 - Stage 2 - NDD & Pavement Removal

NDD and removal of pavement is required to be lifted to allow for the discharge route piping.
6/12/2023 8:00:54 PM - 9/1/2023 5:00:10 AM

Equipment	Quantity	Usage	Reduction	SWL
Excavator (06 tonne)	1	40 %	0	90
Tipper Truck	1	30 %	0	93
Vacc truck	1	50 %	0	109
Bogies	1	30 %	0	95
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 109

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747178	"235 CHURCH ST, PARRAMATTA"	7	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747177	"235 CHURCH ST, PARRAMATTA"	6	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747081	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	19	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	747080	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	18	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	747079	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	17	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747078	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747077	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747076	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747075	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747074	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747073	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747072	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747071	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747070	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747069	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747068	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	747067	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	747066	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	747065	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	89	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	747064	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			83	91	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	747063	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			84	91	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	5	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	4	COM	70	70	70	70			79	87	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	3	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	2	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	1	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746252	"169 MACQUARIE ST, PARRAMATTA"	21	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746251	"169 MACQUARIE ST, PARRAMATTA"	20	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746250	"169 MACQUARIE ST, PARRAMATTA"	19	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746249	"169 MACQUARIE ST, PARRAMATTA"	18	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746248	"169 MACQUARIE ST, PARRAMATTA"	17	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746247	"169 MACQUARIE ST, PARRAMATTA"	16	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746246	"169 MACQUARIE ST, PARRAMATTA"	15	EDU	55	55	55	55			60	67		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable

NCA03	746245	"169 MACQUARIE ST, PARRAMATTA"	14	EDU	55	55	55	55			60	67		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746244	"169 MACQUARIE ST, PARRAMATTA"	13	EDU	55	55	55	55			59	67		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746243	"169 MACQUARIE ST, PARRAMATTA"	12	EDU	55	55	55	55			59	67		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746242	"169 MACQUARIE ST, PARRAMATTA"	11	EDU	55	55	55	55			59	67		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746241	"169 MACQUARIE ST, PARRAMATTA"	10	EDU	55	55	55	55			59	66		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746240	"169 MACQUARIE ST, PARRAMATTA"	9	EDU	55	55	55	55			58	66		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746239	"169 MACQUARIE ST, PARRAMATTA"	8	EDU	55	55	55	55			58	66		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746238	"169 MACQUARIE ST, PARRAMATTA"	7	EDU	55	55	55	55			58	65		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746237	"169 MACQUARIE ST, PARRAMATTA"	6	EDU	55	55	55	55			58	65		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746236	"169 MACQUARIE ST, PARRAMATTA"	5	EDU	55	55	55	55			57	65		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746235	"169 MACQUARIE ST, PARRAMATTA"	4	EDU	55	55	55	55			57	65		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746234	"169 MACQUARIE ST, PARRAMATTA"	3	EDU	55	55	55	55			57	64		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746233	"169 MACQUARIE ST, PARRAMATTA"	2	EDU	55	55	55	55			56	64		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746232	"169 MACQUARIE ST, PARRAMATTA"	1	EDU	55	55	55	55			56	64		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746204	"14 LAMONT ST, PARRAMATTA"	5	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746203	"14 LAMONT ST, PARRAMATTA"	4	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746202	"14 LAMONT ST, PARRAMATTA"	3	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746201	"14 LAMONT ST, PARRAMATTA"	2	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746200	"14 LAMONT ST, PARRAMATTA"	1	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746047	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746046	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746045	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746044	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746043	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746042	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746041	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746040	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746039	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746038	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746037	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746036	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745631	"SE 1 LEVEL 1 100 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745630	"SE 1 LEVEL 1 100 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745364	"330 CHURCH ST, PARRAMATTA"	61	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745363	"330 CHURCH ST, PARRAMATTA"	60	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745362	"330 CHURCH ST, PARRAMATTA"	59	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable

NCA03	745361	"330 CHURCH ST, PARRAMATTA"	58	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745360	"330 CHURCH ST, PARRAMATTA"	57	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745359	"330 CHURCH ST, PARRAMATTA"	56	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745358	"330 CHURCH ST, PARRAMATTA"	55	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745357	"330 CHURCH ST, PARRAMATTA"	54	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745356	"330 CHURCH ST, PARRAMATTA"	53	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745355	"330 CHURCH ST, PARRAMATTA"	52	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745354	"330 CHURCH ST, PARRAMATTA"	51	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745353	"330 CHURCH ST, PARRAMATTA"	50	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745352	"330 CHURCH ST, PARRAMATTA"	49	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745351	"330 CHURCH ST, PARRAMATTA"	48	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745350	"330 CHURCH ST, PARRAMATTA"	47	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745349	"330 CHURCH ST, PARRAMATTA"	46	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745348	"330 CHURCH ST, PARRAMATTA"	45	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	745347	"330 CHURCH ST, PARRAMATTA"	44	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745346	"330 CHURCH ST, PARRAMATTA"	43	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745345	"330 CHURCH ST, PARRAMATTA"	42	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745344	"330 CHURCH ST, PARRAMATTA"	41	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745343	"330 CHURCH ST, PARRAMATTA"	40	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745342	"330 CHURCH ST, PARRAMATTA"	39	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745341	"330 CHURCH ST, PARRAMATTA"	38	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745340	"330 CHURCH ST, PARRAMATTA"	37	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745339	"330 CHURCH ST, PARRAMATTA"	36	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745338	"330 CHURCH ST, PARRAMATTA"	35	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745337	"330 CHURCH ST, PARRAMATTA"	34	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745336	"330 CHURCH ST, PARRAMATTA"	33	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745335	"330 CHURCH ST, PARRAMATTA"	32	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745334	"330 CHURCH ST, PARRAMATTA"	31	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	2	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	1	COM	70	70	70	70			83	91	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745115	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	9	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745114	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	8	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745113	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	7	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745112	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	6	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	5	COM	70	70	70	70			78	86	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	4	COM	70	70	70	70			79	87	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable

NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	3	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745068	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	13	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745067	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745066	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	11	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745065	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	10	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745064	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	9	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745063	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	8	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745062	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	7	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745061	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	6	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745060	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745059	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	4	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745058	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	3	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745057	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	2	COM	70	70	70	70			85	92	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745056	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	1	COM	70	70	70	70			86	94	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745055	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	15	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745054	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	14	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744967	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	8	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744966	"SE 1 LEVEL 35 SMITH ST, PARRAMATTA"	7	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable

NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744889	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744888	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744887	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744886	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744885	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744884	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744883	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744882	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	744881	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744880	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744879	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			85	92	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744878	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			86	94	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			83	91	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744209	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744208	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744207	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744206	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744205	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744204	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744203	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744202	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744201	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744200	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744199	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744198	"SE 2 GROUND 80 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 7 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 2C – Installation of pipeline and pavement reinstatement (Section 2)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 79 dB(A) during the works, resulting in 8 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	79 dB(A)
Number of highly noise affected receivers (>75 dB)	8

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	27
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	27
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	27
Clearly Audible	10 <= 20 dB above NML	0

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	27
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	0
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	28
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 4 - Stage 3 - Installation of Pipeline & Reinstatement of Surface

Installation of pipeline, backfill excavations, compact and reinstate surface with asphalt.
6/12/2023 8:00:09 PM - 9/1/2023 5:00:21 AM

Equipment	Quantity	Usage	Reduction	SWL
Bogies	1	30 %	0	95
Plate compactor (small e.g. 60kg)	1	30 %	0	99
Tipper Truck	1	30 %	0	93
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 102

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747067	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747066	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747065	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747064	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747063	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	4	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	3	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	2	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	1	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	2	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	1	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	5	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	4	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	3	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745060	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745059	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	4	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745058	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	3	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745057	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	2	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745056	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	1	COM	70	70	70	70			78	86	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744882	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744881	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744880	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744879	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744878	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact
NCA03	747067	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	COM	Human Comfort

NCA	Receiver	Address	Land use	Vibration Impact
NCA03	747066	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	747065	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	747064	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	747063	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	745117	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745116	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745111	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745110	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745109	COOPER & LYBRAND HOUSE SE 2 75 GEORGE ST	COM	Human Comfort
NCA03	745060	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	COM	Human Comfort
NCA03	745059	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	COM	Human Comfort
NCA03	745058	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	COM	Human Comfort
NCA03	745057	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	COM	Human Comfort
NCA03	745056	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	COM	Human Comfort
NCA03	744882	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744881	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744880	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744879	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744878	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744541	"94 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744540	"94 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744539	"94 GEORGE ST, PARRAMATTA"	COM	Human Comfort

Attachment 8 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 3A – Saw cutting (Section 3)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 89 dB(A) during the works, resulting in 55 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	89 dB(A)
Number of highly noise affected receivers (>75 dB)	55

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	121
Clearly Audible	10 <= 20 dB above NML	26
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	129
Clearly Audible	10 <= 20 dB above NML	26
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	143
Clearly Audible	10 <= 20 dB above NML	26

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	198
Clearly Audible	10 <= 20 dB above NML	48
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	51
Exceed 65 dBA awakening criterion	17

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 5 - Stage 1 - Saw Cutting Pavement

Pipeline located below ground. Saw cutting will be required for the removal of the footpath and roadway pavement.
6/12/2023 8:00:08 PM - 9/1/2023 10:00:20 PM

Equipment	Quantity	Usage	Reduction	SWL
Concrete Saw (Std)*	1	30 %	3	111
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 111

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747181	"235 CHURCH ST, PARRAMATTA"	3	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	747180	"235 CHURCH ST, PARRAMATTA"	2	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	747179	"235 CHURCH ST, PARRAMATTA"	1	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	747178	"235 CHURCH ST, PARRAMATTA"	7	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747177	"235 CHURCH ST, PARRAMATTA"	6	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747176	"235 CHURCH ST, PARRAMATTA"	5	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747175	"235 CHURCH ST, PARRAMATTA"	4	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747161	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	10	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747160	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	9	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747159	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	8	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	747083	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	21	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747082	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	20	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747081	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	19	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747080	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	18	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747079	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	17	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	747078	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747077	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747076	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747075	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			73	79		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	747074	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747073	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747072	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	80		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	747071	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747070	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747069	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			75	81	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747068	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747067	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747066	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747065	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			76	82	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747064	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			76	82	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	747063	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	747032	"109-113 GEORGE ST, PARRAMATTA"	22	RES	68	63	58	48	Y		57	63		0	0	0	9	-	9	None	None	None	Noticable
NCA03	747031	"109-113 GEORGE ST, PARRAMATTA"	21	RES	68	63	58	48	Y		57	63		0	0	0	9	-	9	None	None	None	Noticable

NCA03	747030	"109-113 GEORGE ST, PARRAMATTA"	20	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	None	Noticable
NCA03	747029	"109-113 GEORGE ST, PARRAMATTA"	19	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747028	"109-113 GEORGE ST, PARRAMATTA"	18	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747027	"109-113 GEORGE ST, PARRAMATTA"	17	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747026	"109-113 GEORGE ST, PARRAMATTA"	16	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747025	"109-113 GEORGE ST, PARRAMATTA"	15	RES	68	63	58	48	Y		55	61		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747024	"109-113 GEORGE ST, PARRAMATTA"	14	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747023	"109-113 GEORGE ST, PARRAMATTA"	13	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747022	"109-113 GEORGE ST, PARRAMATTA"	12	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747021	"109-113 GEORGE ST, PARRAMATTA"	11	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747020	"109-113 GEORGE ST, PARRAMATTA"	10	RES	68	63	58	48	Y		54	60		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747019	"109-113 GEORGE ST, PARRAMATTA"	9	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747018	"109-113 GEORGE ST, PARRAMATTA"	8	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747017	"109-113 GEORGE ST, PARRAMATTA"	7	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747016	"109-113 GEORGE ST, PARRAMATTA"	6	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747015	"109-113 GEORGE ST, PARRAMATTA"	5	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747014	"109-113 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747013	"109-113 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48			53	58		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747012	"109-113 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747011	"109-113 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	5	COM	70	70	70	70			80	86	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	3	COM	70	70	70	70			84	90	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	2	COM	70	70	70	70			87	92	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	1	COM	70	70	70	70			89	94	Y	19	19	19	19	-	19	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746692	"91 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746691	"91 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746690	"91 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			77	83	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746689	"91 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746688	"91 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746687	"91 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746560	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable

NCA03	746559	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746558	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746557	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746498	"LEVEL 1 107 PHILLIP ST, PARRAMATTA"	7	COM	65	65	65	65			66	71		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746454	"11 HASSALL ST, PARRAMATTA"	46	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746453	"11 HASSALL ST, PARRAMATTA"	45	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746452	"11 HASSALL ST, PARRAMATTA"	44	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746451	"11 HASSALL ST, PARRAMATTA"	43	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746450	"11 HASSALL ST, PARRAMATTA"	42	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746449	"11 HASSALL ST, PARRAMATTA"	41	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746448	"11 HASSALL ST, PARRAMATTA"	40	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746447	"11 HASSALL ST, PARRAMATTA"	39	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746446	"11 HASSALL ST, PARRAMATTA"	38	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746445	"11 HASSALL ST, PARRAMATTA"	37	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746444	"11 HASSALL ST, PARRAMATTA"	36	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746170	"150 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746169	"150 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746168	"150 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746167	"150 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746166	"150 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746165	"150 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746164	"150 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746163	"150 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746162	"150 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746161	"150 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746160	"150 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746159	"150 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			79	85	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746085	"76 PHILLIP ST, PARRAMATTA"	6	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746084	"76 PHILLIP ST, PARRAMATTA"	5	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746083	"76 PHILLIP ST, PARRAMATTA"	4	RES	68	63	58	48	Y		55	61		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746082	"76 PHILLIP ST, PARRAMATTA"	3	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746081	"76 PHILLIP ST, PARRAMATTA"	2	RES	68	63	58	48	Y		55	60		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746080	"76 PHILLIP ST, PARRAMATTA"	1	RES	68	63	58	48	Y		54	59		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746047	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746046	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable

NCA03	746045	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746044	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	80	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746043	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746042	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746041	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746040	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746039	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746038	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	88	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746037	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746036	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			85	91	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746011	"95-101 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746010	"95-101 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746009	"95-101 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746008	"95-101 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746007	"95-101 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746006	"95-101 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746005	"95-101 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746004	"95-101 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746003	"95-101 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746002	"95-101 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745800	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	18	EDU	55	55	55	55			64	69		9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745799	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	17	EDU	55	55	55	55			63	69		8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745798	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	16	EDU	55	55	55	55			63	68		8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745797	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	15	EDU	55	55	55	55			63	68		8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745796	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	14	EDU	55	55	55	55			62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745795	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	13	EDU	55	55	55	55			62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745794	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	12	EDU	55	55	55	55			62	67		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745793	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	11	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745792	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	10	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745791	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	9	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745790	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	8	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745789	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	7	EDU	55	55	55	55			59	65		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745788	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	6	EDU	55	55	55	55			59	64		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745787	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	5	EDU	55	55	55	55			59	64		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745786	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	4	EDU	55	55	55	55			58	63		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745785	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	3	EDU	55	55	55	55			58	63		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable

NCA03	745784	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	2	EDU	55	55	55	55			57	62		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745632	"85 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745596	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745595	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745594	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	81	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745593	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745592	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	86	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			85	90	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745466	"130 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745465	"130 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745464	"130 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745463	"130 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745462	"130 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745461	"130 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745460	"130 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745459	"130 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745458	"130 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745457	"130 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745456	"130 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745455	"130 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745454	"130 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745364	"330 CHURCH ST, PARRAMATTA"	61	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745363	"330 CHURCH ST, PARRAMATTA"	60	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745362	"330 CHURCH ST, PARRAMATTA"	59	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745361	"330 CHURCH ST, PARRAMATTA"	58	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745360	"330 CHURCH ST, PARRAMATTA"	57	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745359	"330 CHURCH ST, PARRAMATTA"	56	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745358	"330 CHURCH ST, PARRAMATTA"	55	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745357	"330 CHURCH ST, PARRAMATTA"	54	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745356	"330 CHURCH ST, PARRAMATTA"	53	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745355	"330 CHURCH ST, PARRAMATTA"	52	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745354	"330 CHURCH ST, PARRAMATTA"	51	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable

NCA03	745353	"330 CHURCH ST, PARRAMATTA"	50	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745352	"330 CHURCH ST, PARRAMATTA"	49	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745351	"330 CHURCH ST, PARRAMATTA"	48	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745350	"330 CHURCH ST, PARRAMATTA"	47	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745349	"330 CHURCH ST, PARRAMATTA"	46	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745348	"330 CHURCH ST, PARRAMATTA"	45	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745347	"330 CHURCH ST, PARRAMATTA"	44	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745346	"330 CHURCH ST, PARRAMATTA"	43	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745345	"330 CHURCH ST, PARRAMATTA"	42	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745344	"330 CHURCH ST, PARRAMATTA"	41	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745343	"330 CHURCH ST, PARRAMATTA"	40	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745278	"85 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745277	"85 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745276	"85 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745275	"85 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745274	"85 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745273	"85 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745272	"85 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745271	"85 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745064	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	9	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745063	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	8	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745062	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	7	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745061	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	6	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745060	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	5	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745059	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	4	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745058	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	3	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745057	ANZ BANK OFFICE SE 1 LEVEL 3 20 SMITH ST	2	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	63	68		0	0	5	15	3	15	None	Noticable	Noticable	Clearly Audible
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	63	68		0	0	5	15	3	15	None	None	Noticable	Clearly Audible
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	62	67		0	0	4	14	2	14	None	None	Noticable	Clearly Audible
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	62	67		0	0	4	14	2	14	None	None	Noticable	Clearly Audible
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	61	67		0	0	3	13	2	13	None	None	Noticable	Clearly Audible

NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	61	66		0	0	3	13	1	13	None	None	Noticable	Clearly Audible
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	60	66		0	0	2	12	1	12	None	None	Noticable	Clearly Audible
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	None	Noticable
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y		57	63		0	0	0	9	-	9	None	None	None	Noticable
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	Noticable	Clearly Audible
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	61	66		0	0	3	13	1	13	None	None	Noticable	Clearly Audible
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	61	66		0	0	3	13	1	13	None	None	Noticable	Clearly Audible
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	60	66		0	0	2	12	1	12	None	None	Noticable	Clearly Audible
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	744889	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			73	79		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744888	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744887	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744886	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	80	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	744885	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744884	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744883	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	744882	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	744881	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	744880	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	744879	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744878	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744376	"89 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744375	"89 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			85	90	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744261	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744260	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	3	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744259	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	2	COM	70	70	70	70			83	89	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744258	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	1	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 9 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 3B – NDD and Pavement Removal (Section 3)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 87 dB(A) during the works, resulting in 36 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	87 dB(A)
Number of highly noise affected receivers (>75 dB)	36

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	84
Clearly Audible	10 <= 20 dB above NML	18
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	84
Clearly Audible	10 <= 20 dB above NML	18
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	103
Clearly Audible	10 <= 20 dB above NML	18

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	129
Clearly Audible	10 <= 20 dB above NML	37
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	56
Exceed 65 dBA awakening criterion	19

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 5 - Stage 2 - NDD & Pavement Removal

NDD and removal of pavement is required to be lifted to allow for the discharge route piping.
6/12/2023 8:00:37 PM - 9/1/2023 5:00:51 AM

Equipment	Quantity	Usage	Reduction	SWL
Bogies	1	30 %	0	95
Excavator (06 tonne)	1	40 %	0	90
Tipper Truck	1	30 %	0	93
Vacc truck	1	50 %	0	109
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 109

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747161	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	10	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747160	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	9	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747159	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	8	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	747074	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	747073	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	747072	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747071	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747070	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747069	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747068	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747067	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747066	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	747065	"SE 5 GROUND 100 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	747032	"109-113 GEORGE ST, PARRAMATTA"	22	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747031	"109-113 GEORGE ST, PARRAMATTA"	21	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747030	"109-113 GEORGE ST, PARRAMATTA"	20	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747029	"109-113 GEORGE ST, PARRAMATTA"	19	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747028	"109-113 GEORGE ST, PARRAMATTA"	18	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747027	"109-113 GEORGE ST, PARRAMATTA"	17	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747026	"109-113 GEORGE ST, PARRAMATTA"	16	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747025	"109-113 GEORGE ST, PARRAMATTA"	15	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747024	"109-113 GEORGE ST, PARRAMATTA"	14	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747023	"109-113 GEORGE ST, PARRAMATTA"	13	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747022	"109-113 GEORGE ST, PARRAMATTA"	12	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747021	"109-113 GEORGE ST, PARRAMATTA"	11	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747020	"109-113 GEORGE ST, PARRAMATTA"	10	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747019	"109-113 GEORGE ST, PARRAMATTA"	9	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747018	"109-113 GEORGE ST, PARRAMATTA"	8	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747017	"109-113 GEORGE ST, PARRAMATTA"	7	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747016	"109-113 GEORGE ST, PARRAMATTA"	6	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747015	"109-113 GEORGE ST, PARRAMATTA"	5	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	747014	"109-113 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747013	"109-113 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable

NCA03	747012	"109-113 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	747011	"109-113 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	5	COM	70	70	70	70			79	87	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	4	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	3	COM	70	70	70	70			83	91	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	2	COM	70	70	70	70			85	93	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	1	COM	70	70	70	70			87	95	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746692	"91 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746691	"91 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746690	"91 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746689	"91 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746688	"91 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746687	"91 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	87	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			82	89	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746560	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746559	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746558	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746557	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746454	"11 HASSALL ST, PARRAMATTA"	46	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746453	"11 HASSALL ST, PARRAMATTA"	45	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746452	"11 HASSALL ST, PARRAMATTA"	44	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746451	"11 HASSALL ST, PARRAMATTA"	43	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746450	"11 HASSALL ST, PARRAMATTA"	42	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746164	"150 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746163	"150 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746162	"150 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746161	"150 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746160	"150 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			78	86	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746085	"76 PHILLIP ST, PARRAMATTA"	6	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746084	"76 PHILLIP ST, PARRAMATTA"	5	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746083	"76 PHILLIP ST, PARRAMATTA"	4	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746082	"76 PHILLIP ST, PARRAMATTA"	3	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable

NCA03	746081	"76 PHILLIP ST, PARRAMATTA"	2	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746080	"76 PHILLIP ST, PARRAMATTA"	1	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746047	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746046	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746045	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746044	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746043	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746042	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746041	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746040	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746039	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746038	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746037	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			80	87	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	746036	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746006	"95-101 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746005	"95-101 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746004	"95-101 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746003	"95-101 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745800	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	18	EDU	55	55	55	55			62	70		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745799	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	17	EDU	55	55	55	55			62	70		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745798	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	16	EDU	55	55	55	55			62	69		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745797	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	15	EDU	55	55	55	55			62	69		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745796	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	14	EDU	55	55	55	55			61	69		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745795	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	13	EDU	55	55	55	55			61	69		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745794	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	12	EDU	55	55	55	55			61	68		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745793	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	11	EDU	55	55	55	55			60	67		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745792	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	10	EDU	55	55	55	55			59	67		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745791	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	9	EDU	55	55	55	55			59	66		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745790	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	8	EDU	55	55	55	55			58	66		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745789	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	7	EDU	55	55	55	55			58	66		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745788	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	6	EDU	55	55	55	55			58	65		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745787	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	5	EDU	55	55	55	55			57	65		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745786	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	4	EDU	55	55	55	55			57	64		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745785	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	3	EDU	55	55	55	55			56	64		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745784	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	2	EDU	55	55	55	55			55	63		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745632	"85 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

NCA03	745596	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745595	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745594	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745593	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745592	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			79	87	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			83	91	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745462	"130 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745461	"130 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745460	"130 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745459	"130 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745458	"130 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745457	"130 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745456	"130 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745455	"130 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745454	"130 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	62	70		0	0	4	14	5	14	None	None	Noticable	Clearly Audible
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	62	69		0	0	4	14	4	14	None	None	Noticable	Clearly Audible
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	61	69		0	0	3	13	4	13	None	None	Noticable	Clearly Audible
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	61	68		0	0	3	13	3	13	None	None	Noticable	Clearly Audible
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	60	68		0	0	2	12	3	12	None	None	Noticable	Clearly Audible
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	60	68		0	0	2	12	3	12	None	None	Noticable	Clearly Audible
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	59	67		0	0	1	11	2	11	None	None	Noticable	Clearly Audible
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	59	67		0	0	1	11	2	11	None	None	Noticable	Clearly Audible
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y		57	65		0	0	0	9	-	9	None	None	None	Noticable

NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y		57	64		0	0	0	9	-	9	None	None	None	Noticable
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	60	67		0	0	2	12	2	12	None	None	Noticable	Clearly Audible
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	59	67		0	0	1	11	2	11	None	None	Noticable	Clearly Audible
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	59	67		0	0	1	11	2	11	None	None	Noticable	Clearly Audible
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	59	66		0	0	1	11	1	11	None	None	Noticable	Clearly Audible
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	Noticable	Clearly Audible
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y		58	65		0	0	0	10	-	10	None	None	None	Noticable
NCA03	744889	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744888	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	744887	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744886	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744885	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744884	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744883	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744882	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744881	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744880	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744879	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744878	"LEVEL 9 79 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744376	"89 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744375	"89 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			83	91	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744261	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	4	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744260	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	3	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744259	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	2	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	744258	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	1	COM	70	70	70	70			83	90	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 10 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 3C – Installation of pipeline and pavement reinstatement (Section 3)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 80 dB(A) during the works, resulting in 5 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	80 dB(A)
Number of highly noise affected receivers (>75 dB)	5

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	25
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	25
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	25
Clearly Audible	10 <= 20 dB above NML	0

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	52
Clearly Audible	10 <= 20 dB above NML	0
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	17
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	25
Cosmetic damage	1
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 5 - Stage 3 - Installation of Pavement & Reinstatement of Surface

Installation of pipeline, backfill excavations, compact and reinstate surface with asphalt.
6/12/2023 8:00:46 PM - 9/1/2023 5:00:58 AM

Equipment	Quantity	Usage	Reduction	SWL
Bogies	1	30 %	0	95
Plate compactor (small e.g. 60kg)	1	30 %	0	99
Tipper Truck	1	30 %	0	93
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 102

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747032	"109-113 GEORGE ST, PARRAMATTA"	22	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	747031	"109-113 GEORGE ST, PARRAMATTA"	21	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	747030	"109-113 GEORGE ST, PARRAMATTA"	20	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	5	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	4	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	3	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	2	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	1	COM	70	70	70	70			80	87	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	746687	"91 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746038	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746037	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746036	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745632	"85 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			73	80		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y		54	62		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y		54	61		0	0	0	6	-	6	None	None	None	Noticable
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y		53	61		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y		53	60		0	0	0	5	-	5	None	None	None	Noticable
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y		52	60		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable

NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y		52	59		0	0	0	4	-	4	None	None	None	Noticable
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48			51	58		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744376	"89 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744375	"89 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	744261	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	4	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744260	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	3	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744259	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	2	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	744258	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	1	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact
NCA03	746886	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746885	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746884	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746883	"1 BARRACK LANE, PARRAMATTA"	COM	Human Comfort
NCA03	746882	"1 BARRACK LANE, PARRAMATTA"	COM	Cosmetic
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746039	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746038	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746037	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746036	"LEVEL 6 110 GEORGE ST, PARRAMATTA"	COM	Human Comfort

Construction noise impact statement

NCA	Receiver	Address	Land use	Vibration Impact
NCA03	745632	"85 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744376	"89 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744375	"89 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	744261	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	COM	Human Comfort
NCA03	744260	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	COM	Human Comfort
NCA03	744259	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	COM	Human Comfort
NCA03	744258	"MORETON BAY TERRACE SE 12 83 GEORGE ST,"	COM	Human Comfort

Attachment 11 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 4A – Saw cutting (Section 4)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 90 dB(A) during the works, resulting in 58 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	90 dB(A)
Number of highly noise affected receivers (>75 dB)	58

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	89
Clearly Audible	10 <= 20 dB above NML	25
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	99
Clearly Audible	10 <= 20 dB above NML	42
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	121
Clearly Audible	10 <= 20 dB above NML	37

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	6
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	133
Clearly Audible	10 <= 20 dB above NML	69
Moderately Intrusive	20 <= 30 dB above NML	18
Highly Intrusive	> 30 dB above NML	6

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	85
Exceed 65 dBA awakening criterion	56

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 6 - Stage 1 - Saw Cutting Pavement

Pipeline located below ground. Saw cutting will be required for the removal of the footpath and roadway pavement.
6/12/2023 8:00:37 PM - 9/1/2023 10:00:51 PM

Equipment	Quantity	Usage	Reduction	SWL
Concrete Saw (Std)*	1	30 %	3	111
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 111

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

GAMUDA Australia

LAING O'ROURKE

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747161	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	10	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	747160	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	9	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	747159	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	8	RES	68	63	58	48	Y		59	65		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	747158	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	7	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	747157	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	6	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	747156	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	5	RES	68	63	58	48	Y		58	64		0	0	0	10	-	10	None	None	Noticable	Clearly Audible
NCA03	747155	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	4	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	Noticable	Clearly Audible
NCA03	747154	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	3	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	None	Noticable
NCA03	747153	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	2	RES	68	63	58	48	Y		57	63		0	0	0	9	-	9	None	None	None	Noticable
NCA03	747152	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	1	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	747032	"109-113 GEORGE ST, PARRAMATTA"	22	RES	68	63	58	48	Y	Y	63	68		0	0	5	15	3	15	None	Noticable	Noticable	Clearly Audible
NCA03	747031	"109-113 GEORGE ST, PARRAMATTA"	21	RES	68	63	58	48	Y	Y	66	71		0	3	8	18	6	18	None	Noticable	Noticable	Clearly Audible
NCA03	747030	"109-113 GEORGE ST, PARRAMATTA"	20	RES	68	63	58	48	Y	Y	66	71		0	3	8	18	6	18	None	Noticable	Noticable	Clearly Audible
NCA03	747029	"109-113 GEORGE ST, PARRAMATTA"	19	RES	68	63	58	48	Y	Y	66	71		0	3	8	18	6	18	None	Noticable	Noticable	Clearly Audible
NCA03	747028	"109-113 GEORGE ST, PARRAMATTA"	18	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible
NCA03	747027	"109-113 GEORGE ST, PARRAMATTA"	17	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible
NCA03	747026	"109-113 GEORGE ST, PARRAMATTA"	16	RES	68	63	58	48	Y	Y	64	70		0	1	6	16	5	16	None	Noticable	Noticable	Clearly Audible
NCA03	747025	"109-113 GEORGE ST, PARRAMATTA"	15	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747024	"109-113 GEORGE ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747023	"109-113 GEORGE ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747022	"109-113 GEORGE ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747021	"109-113 GEORGE ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747020	"109-113 GEORGE ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747019	"109-113 GEORGE ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	64	70		0	1	6	16	5	16	None	Noticable	Noticable	Clearly Audible
NCA03	747018	"109-113 GEORGE ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	64	70		0	1	6	16	5	16	None	Noticable	Noticable	Clearly Audible
NCA03	747017	"109-113 GEORGE ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	747016	"109-113 GEORGE ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	61	66		0	0	3	13	1	13	None	None	Noticable	Clearly Audible
NCA03	747015	"109-113 GEORGE ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	61	66		0	0	3	13	1	13	None	None	Noticable	Clearly Audible
NCA03	747014	"109-113 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	747013	"109-113 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y		59	65		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	747012	"109-113 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	747011	"109-113 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y		58	64		0	0	0	10	-	10	None	None	Noticable	Clearly Audible
NCA03	746901	"20 QUEENS AV, PARRAMATTA"	4	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable

NCA03	746900	"20 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746899	"20 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746898	"20 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746879	"13 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			48	53		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746817	"8 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746816	"8 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746692	"91 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746691	"91 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746690	"91 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			77	83	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746689	"91 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746688	"91 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746687	"91 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			83	89	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746571	"30-32 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746570	"30-32 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746569	"30-32 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746560	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	67	72		0	4	9	19	7	19	None	Noticable	Noticable	Clearly Audible
NCA03	746559	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	66	72		0	3	8	18	7	18	None	Noticable	Noticable	Clearly Audible
NCA03	746558	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	66	71		0	3	8	18	6	18	None	Noticable	Noticable	Clearly Audible
NCA03	746557	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible
NCA03	746498	"LEVEL 1 107 PHILLIP ST, PARRAMATTA"	7	COM	65	65	65	65			66	71		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746497	"LEVEL 1 107 PHILLIP ST, PARRAMATTA"	6	COM	65	65	65	65			66	71		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746454	"11 HASSALL ST, PARRAMATTA"	46	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746453	"11 HASSALL ST, PARRAMATTA"	45	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746452	"11 HASSALL ST, PARRAMATTA"	44	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746451	"11 HASSALL ST, PARRAMATTA"	43	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746450	"11 HASSALL ST, PARRAMATTA"	42	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746449	"11 HASSALL ST, PARRAMATTA"	41	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746448	"11 HASSALL ST, PARRAMATTA"	40	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746447	"11 HASSALL ST, PARRAMATTA"	39	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746446	"11 HASSALL ST, PARRAMATTA"	38	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746445	"11 HASSALL ST, PARRAMATTA"	37	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	746444	"11 HASSALL ST, PARRAMATTA"	36	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable

NCA03	746443	"11 HASSALL ST, PARRAMATTA"	35	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746442	"11 HASSALL ST, PARRAMATTA"	34	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746441	"11 HASSALL ST, PARRAMATTA"	33	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746440	"11 HASSALL ST, PARRAMATTA"	32	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746439	"11 HASSALL ST, PARRAMATTA"	31	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746438	"11 HASSALL ST, PARRAMATTA"	30	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746350	"6-10 CHARLES ST, PA"	16	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	746349	"6-10 CHARLES ST, PA"	15	RES	68	63	58	48	Y		60	65		0	0	2	12	-	12	None	None	Noticable	Clearly Audible
NCA03	746348	"6-10 CHARLES ST, PA"	14	RES	68	63	58	48	Y		59	65		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	746347	"6-10 CHARLES ST, PA"	13	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	746346	"6-10 CHARLES ST, PA"	12	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	746345	"6-10 CHARLES ST, PA"	11	RES	68	63	58	48	Y		59	64		0	0	1	11	-	11	None	None	Noticable	Clearly Audible
NCA03	746344	"6-10 CHARLES ST, PA"	10	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	Noticable	Clearly Audible
NCA03	746343	"6-10 CHARLES ST, PA"	9	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	None	Noticable
NCA03	746342	"6-10 CHARLES ST, PA"	8	RES	68	63	58	48	Y		58	63		0	0	0	10	-	10	None	None	None	Noticable
NCA03	746341	"6-10 CHARLES ST, PA"	7	RES	68	63	58	48	Y		57	63		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746340	"6-10 CHARLES ST, PA"	6	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746339	"6-10 CHARLES ST, PA"	5	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746338	"6-10 CHARLES ST, PA"	4	RES	68	63	58	48	Y		57	62		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746337	"6-10 CHARLES ST, PA"	3	RES	68	63	58	48	Y		56	62		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746336	"6-10 CHARLES ST, PA"	2	RES	68	63	58	48	Y		56	61		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746173	"150 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			73	79		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746172	"150 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746171	"150 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			74	80		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746170	"150 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746169	"150 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746168	"150 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746167	"150 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746166	"150 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			77	83	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746165	"150 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746164	"150 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746163	"150 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	85	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746162	"150 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746161	"150 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746160	"150 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746159	"150 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible

NCA03	746154	"150 GEORGE ST, PARRAMATTA"	23	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746153	"150 GEORGE ST, PARRAMATTA"	22	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746152	"150 GEORGE ST, PARRAMATTA"	21	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746151	"150 GEORGE ST, PARRAMATTA"	20	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746150	"150 GEORGE ST, PARRAMATTA"	19	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746149	"150 GEORGE ST, PARRAMATTA"	18	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746148	"150 GEORGE ST, PARRAMATTA"	17	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746147	"150 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746012	"95-101 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	80		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746011	"95-101 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746010	"95-101 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746009	"95-101 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746008	"95-101 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			78	83	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746007	"95-101 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	85	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746006	"95-101 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			81	86	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746005	"95-101 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			83	88	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746004	"95-101 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			85	90	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746003	"95-101 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			88	93	Y	18	18	18	18	-	18	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746002	"95-101 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			90	95	Y	20	20	20	20	-	20	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746001	"95-101 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746000	"95-101 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745999	"95-101 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745998	"95-101 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745997	"95-101 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	79		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745949	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			52	58		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745948	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745800	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	18	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745799	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	17	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745798	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	16	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745797	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	15	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745796	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	14	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745795	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	13	EDU	55	55	55	55			62	67		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745794	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	12	EDU	55	55	55	55			62	67		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745793	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	11	EDU	55	55	55	55			62	67		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745792	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	10	EDU	55	55	55	55			61	67		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable

NCA03	745791	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	9	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745790	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	8	EDU	55	55	55	55			61	66		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745789	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	7	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745788	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	6	EDU	55	55	55	55			60	65		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745787	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	5	EDU	55	55	55	55			59	64		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745786	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	4	EDU	55	55	55	55			58	64		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745785	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	3	EDU	55	55	55	55			58	63		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745784	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	2	EDU	55	55	55	55			57	62		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745653	"6A QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745652	"6A QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745635	"135 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745634	"135 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745633	"135 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745605	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745604	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			52	57		0	0	0	4	-	4	None	None	None	Noticable
NCA03	745596	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	80		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745595	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	81	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745594	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	81	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745593	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	83	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745592	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			79	84	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			80	85	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			82	87	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			84	89	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			87	92	Y	17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			90	95	Y	20	20	20	20	-	20	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745463	"130 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			70	75		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745462	"130 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745461	"130 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745460	"130 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745459	"130 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745458	"130 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745457	"130 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745456	"130 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			71	77		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745455	"130 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			70	76		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745130	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible
NCA03	745129	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible

NCA03	745128	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible
NCA03	745127	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	65	70		0	2	7	17	5	17	None	Noticable	Noticable	Clearly Audible
NCA03	745126	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	745125	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	64	69		0	1	6	16	4	16	None	Noticable	Noticable	Clearly Audible
NCA03	745124	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	63	68		0	0	5	15	3	15	None	Noticable	Noticable	Clearly Audible
NCA03	745123	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	63	68		0	0	5	15	3	15	None	None	Noticable	Clearly Audible
NCA03	745122	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	62	67		0	0	4	14	2	14	None	None	Noticable	Clearly Audible
NCA03	745121	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	61	67		0	0	3	13	2	13	None	None	Noticable	Clearly Audible
NCA03	744983	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	75	80		7	12	17	27	15	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	75	80	Y	7	12	17	27	15	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	76	81	Y	8	13	18	28	16	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	77	82	Y	9	14	19	29	17	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	77	82	Y	9	14	19	29	17	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	78	83	Y	10	15	20	30	18	30	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	79	84	Y	11	16	21	31	19	31	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	79	85	Y	11	16	21	31	20	31	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	80	85	Y	12	17	22	32	20	32	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	80	86	Y	12	17	22	32	21	32	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	81	86	Y	13	18	23	33	21	33	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	73	78		5	10	15	25	13	25	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	73	79		5	10	15	25	14	25	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	74	79		6	11	16	26	14	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	78	83	Y	10	15	20	30	18	30	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	78	83	Y	10	15	20	30	18	30	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	77	82	Y	9	14	19	29	17	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	78	83	Y	10	15	20	30	18	30	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	74	79		6	11	16	26	14	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	74	80		6	11	16	26	15	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	75	80		7	12	17	27	15	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	75	81	Y	7	12	17	27	16	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	76	81	Y	8	13	18	28	16	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	77	82	Y	9	14	19	29	17	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744839	"14 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			50	56		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744838	"14 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744837	"14 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable

NCA03	744702	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744701	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744462	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			51	57		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744461	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			51	56		0	0	0	3	-	3	None	None	None	Noticable
NCA03	744376	"89 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			73	78		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	744375	"89 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			72	77		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744356	"4 QUEENS AV, PARRAMATTA"	4	RES	68	63	58	48			50	55		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744355	"4 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			49	55		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744354	"4 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744353	"4 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744196	"22 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744195	"22 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			49	54		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744194	"22 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			48	54		0	0	0	0	-	0	None	None	None	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 12 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 4B – NDD and Pavement Removal (Section 4)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 89 dB(A) during the works, resulting in 47 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	89 dB(A)
Number of highly noise affected receivers (>75 dB)	47

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	81
Clearly Audible	10 <= 20 dB above NML	18
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	78
Clearly Audible	10 <= 20 dB above NML	34
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	97
Clearly Audible	10 <= 20 dB above NML	36

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	3
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	121
Clearly Audible	10 <= 20 dB above NML	52
Moderately Intrusive	20 <= 30 dB above NML	21
Highly Intrusive	> 30 dB above NML	3

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	86
Exceed 65 dBA awakening criterion	64

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 6 - Stage 2 - NDD & Pavement Removal

NDD and removal of pavement is required to be lifted to allow for the discharge route piping.
6/12/2023 8:00:05 PM - 9/1/2023 5:00:20 AM

Equipment	Quantity	Usage	Reduction	SWL
Bogies	1	30 %	0	95
Excavator (06 tonne)	1	40 %	0	90
Tipper Truck	1	30 %	0	93
Vacc truck	1	50 %	0	109
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75

Activity Sound Power Level: 109

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747161	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	59	66		0	0	1	11	1	11	None	None	Noticable	Clearly Audible
NCA03	747160	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	Noticable	Clearly Audible
NCA03	747159	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	None	Noticable
NCA03	747158	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	7	RES	68	63	58	48	Y		58	65		0	0	0	10	-	10	None	None	None	Noticable
NCA03	747157	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	6	RES	68	63	58	48	Y		57	65		0	0	0	9	-	9	None	None	None	Noticable
NCA03	747156	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	5	RES	68	63	58	48	Y		57	65		0	0	0	9	-	9	None	None	None	Noticable
NCA03	747155	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	4	RES	68	63	58	48	Y		57	64		0	0	0	9	-	9	None	None	None	Noticable
NCA03	747154	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	3	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747153	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	2	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747152	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	1	RES	68	63	58	48	Y		56	63		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747032	"109-113 GEORGE ST, PARRAMATTA"	22	RES	68	63	58	48	Y	Y	62	69		0	0	4	14	4	14	None	None	Noticable	Clearly Audible
NCA03	747031	"109-113 GEORGE ST, PARRAMATTA"	21	RES	68	63	58	48	Y	Y	64	72		0	1	6	16	7	16	None	Noticable	Noticable	Clearly Audible
NCA03	747030	"109-113 GEORGE ST, PARRAMATTA"	20	RES	68	63	58	48	Y	Y	64	72		0	1	6	16	7	16	None	Noticable	Noticable	Clearly Audible
NCA03	747029	"109-113 GEORGE ST, PARRAMATTA"	19	RES	68	63	58	48	Y	Y	64	72		0	1	6	16	7	16	None	Noticable	Noticable	Clearly Audible
NCA03	747028	"109-113 GEORGE ST, PARRAMATTA"	18	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	Noticable	Noticable	Clearly Audible
NCA03	747027	"109-113 GEORGE ST, PARRAMATTA"	17	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	Noticable	Noticable	Clearly Audible
NCA03	747026	"109-113 GEORGE ST, PARRAMATTA"	16	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	None	Noticable	Clearly Audible
NCA03	747025	"109-113 GEORGE ST, PARRAMATTA"	15	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747024	"109-113 GEORGE ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747023	"109-113 GEORGE ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747022	"109-113 GEORGE ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747021	"109-113 GEORGE ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747020	"109-113 GEORGE ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747019	"109-113 GEORGE ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	None	Noticable	Clearly Audible
NCA03	747018	"109-113 GEORGE ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	None	Noticable	Clearly Audible
NCA03	747017	"109-113 GEORGE ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	747016	"109-113 GEORGE ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	60	67		0	0	2	12	2	12	None	None	Noticable	Clearly Audible
NCA03	747015	"109-113 GEORGE ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	59	67		0	0	1	11	2	11	None	None	Noticable	Clearly Audible
NCA03	747014	"109-113 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	59	66		0	0	1	11	1	11	None	None	Noticable	Clearly Audible
NCA03	747013	"109-113 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	None	Noticable
NCA03	747012	"109-113 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y		58	65		0	0	0	10	-	10	None	None	None	Noticable
NCA03	747011	"109-113 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y		57	65		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746901	"20 QUEENS AV, PARRAMATTA"	4	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable

NCA03	746900	"20 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746817	"8 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746816	"8 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	746692	"91 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746691	"91 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746690	"91 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746689	"91 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746688	"91 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			78	85	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746687	"91 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	87	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746560	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	66	73		0	3	8	18	8	18	None	Noticable	Noticable	Clearly Audible
NCA03	746559	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	65	73		0	2	7	17	8	17	None	Noticable	Noticable	Clearly Audible
NCA03	746558	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	64	72		0	1	6	16	7	16	None	Noticable	Noticable	Clearly Audible
NCA03	746557	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	Noticable	Noticable	Clearly Audible
NCA03	746454	"11 HASSALL ST, PARRAMATTA"	46	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746453	"11 HASSALL ST, PARRAMATTA"	45	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746452	"11 HASSALL ST, PARRAMATTA"	44	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746451	"11 HASSALL ST, PARRAMATTA"	43	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746450	"11 HASSALL ST, PARRAMATTA"	42	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746449	"11 HASSALL ST, PARRAMATTA"	41	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746448	"11 HASSALL ST, PARRAMATTA"	40	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746447	"11 HASSALL ST, PARRAMATTA"	39	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746446	"11 HASSALL ST, PARRAMATTA"	38	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746445	"11 HASSALL ST, PARRAMATTA"	37	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746444	"11 HASSALL ST, PARRAMATTA"	36	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746443	"11 HASSALL ST, PARRAMATTA"	35	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	746442	"11 HASSALL ST, PARRAMATTA"	34	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746441	"11 HASSALL ST, PARRAMATTA"	33	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746440	"11 HASSALL ST, PARRAMATTA"	32	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746439	"11 HASSALL ST, PARRAMATTA"	31	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	746350	"6-10 CHARLES ST, PA"	16	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	Noticable	Clearly Audible
NCA03	746349	"6-10 CHARLES ST, PA"	15	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	Noticable	Clearly Audible
NCA03	746348	"6-10 CHARLES ST, PA"	14	RES	68	63	58	48	Y	Y	58	66		0	0	0	10	1	10	None	None	None	Noticable

NCA03	746347	"6-10 CHARLES ST, PA"	13	RES	68	63	58	48	Y		58	65		0	0	0	10	-	10	None	None	None	Noticable
NCA03	746346	"6-10 CHARLES ST, PA"	12	RES	68	63	58	48	Y		57	65		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746345	"6-10 CHARLES ST, PA"	11	RES	68	63	58	48	Y		57	65		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746344	"6-10 CHARLES ST, PA"	10	RES	68	63	58	48	Y		57	64		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746343	"6-10 CHARLES ST, PA"	9	RES	68	63	58	48	Y		57	64		0	0	0	9	-	9	None	None	None	Noticable
NCA03	746342	"6-10 CHARLES ST, PA"	8	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746341	"6-10 CHARLES ST, PA"	7	RES	68	63	58	48	Y		56	64		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746340	"6-10 CHARLES ST, PA"	6	RES	68	63	58	48	Y		56	63		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746339	"6-10 CHARLES ST, PA"	5	RES	68	63	58	48	Y		56	63		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746338	"6-10 CHARLES ST, PA"	4	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746337	"6-10 CHARLES ST, PA"	3	RES	68	63	58	48	Y		55	63		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746336	"6-10 CHARLES ST, PA"	2	RES	68	63	58	48	Y		55	62		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746173	"150 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746172	"150 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746171	"150 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746170	"150 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746169	"150 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746168	"150 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746167	"150 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	83	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746166	"150 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746165	"150 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746164	"150 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746163	"150 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			78	86	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746162	"150 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			79	87	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746161	"150 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746160	"150 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			82	89	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746159	"150 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			82	90	Y	12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746150	"150 GEORGE ST, PARRAMATTA"	19	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746149	"150 GEORGE ST, PARRAMATTA"	18	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746148	"150 GEORGE ST, PARRAMATTA"	17	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746147	"150 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			81	88	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746012	"95-101 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746011	"95-101 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			74	81		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746010	"95-101 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746009	"95-101 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			76	83	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable

NCA03	746008	"95-101 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			77	84	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746007	"95-101 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			78	86	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746006	"95-101 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	87	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746005	"95-101 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			81	89	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746004	"95-101 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			84	91	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746003	"95-101 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			86	94	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746002	"95-101 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			88	96	Y	18	18	18	18	-	18	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746001	"95-101 GEORGE ST, PARRAMATTA"	16	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746000	"95-101 GEORGE ST, PARRAMATTA"	15	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745999	"95-101 GEORGE ST, PARRAMATTA"	14	COM	70	70	70	70			71	79		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745998	"95-101 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745997	"95-101 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			72	80		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745949	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48	Y		51	59		0	0	0	3	-	3	None	None	None	Noticable
NCA03	745948	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745800	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	18	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745799	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	17	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745798	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	16	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745797	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	15	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745796	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	14	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745795	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	13	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745794	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	12	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745793	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	11	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745792	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	10	EDU	55	55	55	55			60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745791	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	9	EDU	55	55	55	55			60	67		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745790	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	8	EDU	55	55	55	55			59	67		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745789	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	7	EDU	55	55	55	55			59	66		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745788	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	6	EDU	55	55	55	55			58	66		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745787	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	5	EDU	55	55	55	55			58	65		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745786	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	4	EDU	55	55	55	55			57	65		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745785	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	3	EDU	55	55	55	55			57	64		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745784	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	2	EDU	55	55	55	55			55	63		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745653	"6A QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745652	"6A QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745635	"135 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	745634	"135 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745633	"135 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable

NCA03	745605	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745604	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	745596	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			73	81		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745595	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			74	82		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	745594	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			75	82		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	745593	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			76	84	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745592	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			77	85	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			79	86	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			80	88	Y	10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			83	90	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			86	93	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			89	96	Y	19	19	19	19	-	19	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745130	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	64	71		0	1	6	16	6	16	None	Noticable	Noticable	Clearly Audible
NCA03	745129	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	64	71		0	1	6	16	6	16	None	Noticable	Noticable	Clearly Audible
NCA03	745128	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	64	71		0	1	6	16	6	16	None	Noticable	Noticable	Clearly Audible
NCA03	745127	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	63	71		0	0	5	15	6	15	None	Noticable	Noticable	Clearly Audible
NCA03	745126	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	63	70		0	0	5	15	5	15	None	None	Noticable	Clearly Audible
NCA03	745125	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	62	70		0	0	4	14	5	14	None	None	Noticable	Clearly Audible
NCA03	745124	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	62	69		0	0	4	14	4	14	None	None	Noticable	Clearly Audible
NCA03	745123	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	61	69		0	0	3	13	4	13	None	None	Noticable	Clearly Audible
NCA03	745122	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	61	68		0	0	3	13	3	13	None	None	Noticable	Clearly Audible
NCA03	745121	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	60	68		0	0	2	12	3	12	None	None	Noticable	Clearly Audible
NCA03	744983	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	73	81		5	10	15	25	16	25	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	74	81		6	11	16	26	16	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	74	82		6	11	16	26	17	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	75	83	Y	7	12	17	27	18	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	76	83	Y	8	13	18	28	18	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	77	84	Y	9	14	19	29	19	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	77	85	Y	9	14	19	29	20	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	78	86	Y	10	15	20	30	21	30	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	79	86	Y	11	16	21	31	21	31	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	79	87	Y	11	16	21	31	22	31	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	79	87	Y	11	16	21	31	22	31	Clearly Audible	Clearly Audible	Moderately Intrusive	Highly Intrusive
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	71	79		3	8	13	23	14	23	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	72	80		4	9	14	24	15	24	Noticable	Noticable	Clearly Audible	Moderately Intrusive

NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	73	80		5	10	15	25	15	25	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	77	84	Y	9	14	19	29	19	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	77	84	Y	9	14	19	29	19	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	76	83	Y	8	13	18	28	18	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	76	84	Y	8	13	18	28	19	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	73	80		5	10	15	25	15	25	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	73	81		5	10	15	25	16	25	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	74	81		6	11	16	26	16	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	74	82		6	11	16	26	17	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	75	82		7	12	17	27	17	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	75	83	Y	7	12	17	27	18	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744839	"14 QUEENS AV, PARRAMATTA"	3	RES	68	63	58	48			49	57		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744838	"14 QUEENS AV, PARRAMATTA"	2	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744837	"14 QUEENS AV, PARRAMATTA"	1	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744702	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			49	56		0	0	0	1	-	1	None	None	None	Noticable
NCA03	744462	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			50	58		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744461	"13 ROBERTSON ST, PARRAMATTA"	1	RES	68	63	58	48			50	57		0	0	0	2	-	2	None	None	None	Noticable
NCA03	744376	"89 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			72	79		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	744375	"89 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			70	78		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	744356	"4 QUEENS AV, PARRAMATTA"	4	RES	68	63	58	48			48	56		0	0	0	0	-	0	None	None	None	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Attachment 13 – Construction Noise & Vibration Assessment – Parramatta Metro Station Construction Site – WTP Discharge line Installation – Stage 4C – Installation of pipeline and pavement reinstatement (Section 4)

George St Water Discharge Route

Project	SMW WTP - Westmead and Parramatta		
Client	Gamuda Laing O'Rourke Consortium		
Assessment Date	02/03/2023	Assessment Id	PARRA-036
Proposed start date	12/06/2023	Proposed end date	01/09/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Western Tunnelling Package is being delivered by the Gamuda Australia and Laing O'Rourke Consortium (GLC) and includes twin nine-kilometre tunnels between Sydney Olympic Park and Westmead, excavation of two new metro stations, and a stabling and maintenance facility at Clyde (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare a Construction noise and vibration impact statement (CNIS) for site and activity-specific noise works and provide ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This CNIS has been prepared using KNOWnoise™ and addresses activities for construction of the Westmead and Parramatta station boxes and utilities corridor between the two sites, as illustrated in Figure 1.

The structure of this CNIS includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Mitigation and management, including consultation

1.2 Planned works

GLC plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

GLC proposes the works subject to this assessment outside approved construction hours for the following reason.

- Works are required to be completed outside of standard construction hours as (a) the applicable council permits and Road Occupancy License (ROL) for access to the footpaths and road network will only be issued for non-peak periods (i.e. weekend, evening and night works) along Smith Street; and (b) works are required to be completed without obstructing access to the public and adjacent commercial premises).

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Westmead study area is centred on the Westmead metro station construction site. The construction site is located to the south of the existing Westmead Station and is bound by Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

The Parramatta study area is centred on the Parramatta metro station construction site. The construction site is located between George Street and Macquarie Street, and between Church Street and Smith Street.

Existing noise levels in this study area are controlled by road traffic noise and general urban hum associated with the CBD. As with any CBD, existing noise levels and are relatively high during the daytime, evening and night-time. The area surrounding the construction site is mainly commercial and the nearest receivers are close to the boundary of the site. The nearest receivers are typically of general office or retail use.

1.2 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Westmead and Parramatta sites have been divided into Noise Catchment Areas (NCAs). The Westmead site contains two noise catchments (NCA01 and NCA02) and NCA03 comprises the Parramatta CBD.

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description
1	Westmead	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
2		South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.
3	Parramatta	Covers Parramatta CBD and is mainly commercial. Residential receivers are generally on the outskirts of the catchment. There are many 'other sensitive' receivers in this catchment, including Western Sydney University, Arthur Phillip High School, Parramatta Public School, and a number of hotels and places of worship.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under EPL or out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under EPL or out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG, based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
1	58	75	53	51	46	46	56
2	59	75	54	52	42	42	52
3	68	75	63	58	48	48	58

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (Sydney Metro 2020)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	N	0 to 10	-
	CA	10 to 20	LB
	MI	20 to 30	LB, M, SN
	HI	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	N	0 to 10	LB
	CA	10 to 20	LB, M
	MI	20 to 30	LB, M, SN, RO
	HI	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	N	0 to 10	LB
	CA	10 to 20	LB, M, SN, RO
	MI	20 to 30	LB, M, SN, IB, PC, RO, AA
	HI	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

N = Noticeable CA = Clearly audible MI Moderately intrusive HI = Highly intrusive

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by GLC were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

Table 10 presents the worst-case predicted noise level of 86 dB(A) during the works, resulting in 26 receivers classed as highly noise affected.

Table 10 Summary of maximum predicted noise level and highly affected receivers for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level	86 dB(A)
Number of highly noise affected receivers (>75 dB)	26

With reference to the CNVS, the number of senstive receivers classified in each impact class for each assessment period are summarised in the following tables.

Table 11 Summary of NML exceedance ranges for standard hours.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	77
Clearly Audible	10 <= 20 dB above NML	5
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 12 Summary of NML exceedance ranges for outside standard hours - weekend.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	68
Clearly Audible	10 <= 20 dB above NML	14
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 13 Summary of NML exceedance ranges for outside standard hours - evenings.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	81
Clearly Audible	10 <= 20 dB above NML	29

Impact class	Predicted noise level	Predicted number of receivers
Moderately Intrusive	20 <= 30 dB above NML	0
Highly Intrusive	> 30 dB above NML	0

Table 14 Summary of NML exceedance ranges for outside standard hours - nights.

Impact class	Predicted noise level	Predicted number of receivers
Noticable	0 <= 10 dB above NML	87
Clearly Audible	10 <= 20 dB above NML	33
Moderately Intrusive	20 <= 30 dB above NML	24
Highly Intrusive	> 30 dB above NML	0

In the event works are planned for more than two consecutive nights, sleep disturbance has been considered. Table 15 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 15 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	85
Exceed 65 dBA awakening criterion	56

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 16. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 16 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	18
Cosmetic damage	3
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in in Table 14.

Table 17 and additional mitigation measures for each receiver identified in Appendix B and summarised in Table 14.

Table 17 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	Mitigation mesasures as per Project NVMP & DNVIS.

Table 18 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Section 6 - Stage 3 - Installation of Pipeline & Reinstate Surface

Installation of pipeline, backfill excavations, compact and reinstate surface with asphalt.
6/12/2023 8:00:08 PM - 9/1/2023 5:00:19 AM

Equipment	Quantity	Usage	Reduction	SWL
Bogies	1	30 %	0	95
Plate compactor (small e.g. 60kg)	1	30 %	0	99
Tipper Truck	1	30 %	0	93
Daymakers / Lighting plant	1	100 %	0	93
Light vehicle	1	10 %	0	75
Diamond core drill (e.g Hilti DD150)	1	10 %	0	105

Activity Sound Power Level: 107

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

GAMUDA Australia

LAING O'ROURKE

Construction noise impact statement

Assessment: George St Water Discharge Route					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Awake	Screen	Day	O/day	Eve	Night
NCA03	747161	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	10	RES	68	63	58	48	Y		56	65		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747160	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	9	RES	68	63	58	48	Y		56	65		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747159	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	8	RES	68	63	58	48	Y		55	65		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747158	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	7	RES	68	63	58	48	Y		55	64		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747157	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	6	RES	68	63	58	48	Y		55	64		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747156	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	5	RES	68	63	58	48	Y		54	64		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747155	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	4	RES	68	63	58	48	Y		54	63		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747154	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	3	RES	68	63	58	48	Y		54	63		0	0	0	6	-	6	None	None	None	Noticable
NCA03	747153	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	2	RES	68	63	58	48	Y		53	63		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747152	"SE 3 LEVEL 2 96 PHILLIP ST, PARRAMATTA"	1	RES	68	63	58	48	Y		53	62		0	0	0	5	-	5	None	None	None	Noticable
NCA03	747032	"109-113 GEORGE ST, PARRAMATTA"	22	RES	68	63	58	48	Y	Y	59	68		0	0	1	11	3	11	None	None	Noticable	Clearly Audible
NCA03	747031	"109-113 GEORGE ST, PARRAMATTA"	21	RES	68	63	58	48	Y	Y	61	71		0	0	3	13	6	13	None	None	Noticable	Clearly Audible
NCA03	747030	"109-113 GEORGE ST, PARRAMATTA"	20	RES	68	63	58	48	Y	Y	62	71		0	0	4	14	6	14	None	None	Noticable	Clearly Audible
NCA03	747029	"109-113 GEORGE ST, PARRAMATTA"	19	RES	68	63	58	48	Y	Y	62	71		0	0	4	14	6	14	None	None	Noticable	Clearly Audible
NCA03	747028	"109-113 GEORGE ST, PARRAMATTA"	18	RES	68	63	58	48	Y	Y	60	70		0	0	2	12	5	12	None	None	Noticable	Clearly Audible
NCA03	747027	"109-113 GEORGE ST, PARRAMATTA"	17	RES	68	63	58	48	Y	Y	61	70		0	0	3	13	5	13	None	None	Noticable	Clearly Audible
NCA03	747026	"109-113 GEORGE ST, PARRAMATTA"	16	RES	68	63	58	48	Y	Y	60	70		0	0	2	12	5	12	None	None	Noticable	Clearly Audible
NCA03	747025	"109-113 GEORGE ST, PARRAMATTA"	15	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747024	"109-113 GEORGE ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747023	"109-113 GEORGE ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747022	"109-113 GEORGE ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747021	"109-113 GEORGE ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747020	"109-113 GEORGE ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747019	"109-113 GEORGE ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	60	70		0	0	2	12	5	12	None	None	Noticable	Clearly Audible
NCA03	747018	"109-113 GEORGE ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	60	70		0	0	2	12	5	12	None	None	Noticable	Clearly Audible
NCA03	747017	"109-113 GEORGE ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	747016	"109-113 GEORGE ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	57	66		0	0	0	9	1	9	None	None	None	Noticable
NCA03	747015	"109-113 GEORGE ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	56	66		0	0	0	8	1	8	None	None	None	Noticable
NCA03	747014	"109-113 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y		56	65		0	0	0	8	-	8	None	None	None	Noticable
NCA03	747013	"109-113 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y		55	65		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747012	"109-113 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y		55	64		0	0	0	7	-	7	None	None	None	Noticable
NCA03	747011	"109-113 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y		54	64		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746692	"91 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			72	81		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable

NCA03	746691	"91 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			72	82		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746690	"91 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			73	83		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746689	"91 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			74	83		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746688	"91 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			75	84		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746687	"91 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			76	85	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			77	86	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			78	87	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			79	88	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			79	89	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746560	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	63	72		0	0	5	15	7	15	None	None	Noticable	Clearly Audible
NCA03	746559	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	62	72		0	0	4	14	7	14	None	None	Noticable	Clearly Audible
NCA03	746558	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	61	71		0	0	3	13	6	13	None	None	Noticable	Clearly Audible
NCA03	746557	"SE 2 LEVEL 2 107 GEORGE ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	60	70		0	0	2	12	5	12	None	None	Noticable	Clearly Audible
NCA03	746350	"6-10 CHARLES ST, PA"	16	RES	68	63	58	48	Y		56	65		0	0	0	8	-	8	None	None	None	Noticable
NCA03	746349	"6-10 CHARLES ST, PA"	15	RES	68	63	58	48	Y		55	65		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746348	"6-10 CHARLES ST, PA"	14	RES	68	63	58	48	Y		55	65		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746347	"6-10 CHARLES ST, PA"	13	RES	68	63	58	48	Y		55	64		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746346	"6-10 CHARLES ST, PA"	12	RES	68	63	58	48	Y		55	64		0	0	0	7	-	7	None	None	None	Noticable
NCA03	746345	"6-10 CHARLES ST, PA"	11	RES	68	63	58	48	Y		54	64		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746344	"6-10 CHARLES ST, PA"	10	RES	68	63	58	48	Y		54	63		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746343	"6-10 CHARLES ST, PA"	9	RES	68	63	58	48	Y		54	63		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746342	"6-10 CHARLES ST, PA"	8	RES	68	63	58	48	Y		54	63		0	0	0	6	-	6	None	None	None	Noticable
NCA03	746341	"6-10 CHARLES ST, PA"	7	RES	68	63	58	48	Y		53	63		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746340	"6-10 CHARLES ST, PA"	6	RES	68	63	58	48	Y		53	62		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746339	"6-10 CHARLES ST, PA"	5	RES	68	63	58	48	Y		53	62		0	0	0	5	-	5	None	None	None	Noticable
NCA03	746338	"6-10 CHARLES ST, PA"	4	RES	68	63	58	48	Y		52	62		0	0	0	4	-	4	None	None	None	Noticable
NCA03	746337	"6-10 CHARLES ST, PA"	3	RES	68	63	58	48	Y		52	62		0	0	0	4	-	4	None	None	None	Noticable
NCA03	746336	"6-10 CHARLES ST, PA"	2	RES	68	63	58	48	Y		52	61		0	0	0	4	-	4	None	None	None	Noticable
NCA03	746171	"150 GEORGE ST, PARRAMATTA"	13	COM	70	70	70	70			70	80		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746170	"150 GEORGE ST, PARRAMATTA"	12	COM	70	70	70	70			71	80		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746169	"150 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			71	81		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746168	"150 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			72	81		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746167	"150 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			73	82		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746166	"150 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			73	83		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746165	"150 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			74	83		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746164	"150 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			75	84		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable

NCA03	746163	"150 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			75	85	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746162	"150 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			76	86	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	746161	"150 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			78	87	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746160	"150 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			79	88	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746159	"150 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			80	89	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			78	87	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	746012	"95-101 GEORGE ST, PARRAMATTA"	11	COM	70	70	70	70			70	80		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	746011	"95-101 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			71	80		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	746010	"95-101 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			72	81		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	746009	"95-101 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			73	82		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	746008	"95-101 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			74	83		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA03	746007	"95-101 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			75	85	Y	5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA03	746006	"95-101 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			77	86	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA03	746005	"95-101 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			79	88	Y	9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA03	746004	"95-101 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			81	90	Y	11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746003	"95-101 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			84	93	Y	14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	746002	"95-101 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			85	95	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745949	"13 ROBERTSON ST, PARRAMATTA"	2	RES	68	63	58	48			48	58		0	0	0	0	-	0	None	None	None	Noticable
NCA03	745800	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	18	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745799	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	17	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745798	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	16	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745797	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	15	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745796	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	14	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745795	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	13	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745794	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	12	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745793	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	11	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745792	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	10	EDU	55	55	55	55			57	67		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745791	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	9	EDU	55	55	55	55			57	66		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745790	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	8	EDU	55	55	55	55			56	66		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745789	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	7	EDU	55	55	55	55			56	65		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745788	ARTHUR PHILIP HIGH SCHOOL 80-100 MACQUAR	6	EDU	55	55	55	55			55	65		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745596	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	10	COM	70	70	70	70			70	80		0	0	0	0	-	0	Noticable	Noticable	Noticable	Noticable
NCA03	745595	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	9	COM	70	70	70	70			71	81		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA03	745594	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	8	COM	70	70	70	70			72	81		2	2	2	2	-	2	Noticable	Noticable	Noticable	Noticable
NCA03	745593	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	7	COM	70	70	70	70			73	83		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA03	745592	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	6	COM	70	70	70	70			74	84		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable

NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	5	COM	70	70	70	70			76	85	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	4	COM	70	70	70	70			78	87	Y	8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	3	COM	70	70	70	70			80	89	Y	10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	2	COM	70	70	70	70			83	92	Y	13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	1	COM	70	70	70	70			86	95	Y	16	16	16	16	-	16	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA03	745130	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	61	70		0	0	3	13	5	13	None	None	Noticable	Clearly Audible
NCA03	745129	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	61	70		0	0	3	13	5	13	None	None	Noticable	Clearly Audible
NCA03	745128	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	61	70		0	0	3	13	5	13	None	None	Noticable	Clearly Audible
NCA03	745127	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	61	70		0	0	3	13	5	13	None	None	Noticable	Clearly Audible
NCA03	745126	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	60	69		0	0	2	12	4	12	None	None	Noticable	Clearly Audible
NCA03	745125	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	59	69		0	0	1	11	4	11	None	None	Noticable	Clearly Audible
NCA03	745124	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	59	68		0	0	1	11	3	11	None	None	Noticable	Clearly Audible
NCA03	745123	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	58	68		0	0	0	10	3	10	None	None	Noticable	Clearly Audible
NCA03	745122	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	58	67		0	0	0	10	2	10	None	None	None	Noticable
NCA03	745121	"SE 1 LEVEL 2 20 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	57	67		0	0	0	9	2	9	None	None	None	Noticable
NCA03	744949	"30 CHARLES ST, PARRAMATTA"	11	RES	68	63	58	48	Y	Y	70	80		2	7	12	22	15	22	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744948	"30 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	71	80		3	8	13	23	15	23	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744947	"30 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	72	81		4	9	14	24	16	24	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744946	"30 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	72	82		4	9	14	24	17	24	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744945	"30 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	73	82		5	10	15	25	17	25	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744944	"30 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	74	83		6	11	16	26	18	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744943	"30 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	74	84		6	11	16	26	19	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744942	"30 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	75	85	Y	7	12	17	27	20	27	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744941	"30 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	76	85	Y	8	13	18	28	20	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744940	"30 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	76	86	Y	8	13	18	28	21	28	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744939	"30 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	77	86	Y	9	14	19	29	21	29	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744938	"30 CHARLES ST, PARRAMATTA"	14	RES	68	63	58	48	Y	Y	69	78		1	6	11	21	13	21	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744937	"30 CHARLES ST, PARRAMATTA"	13	RES	68	63	58	48	Y	Y	69	79		1	6	11	21	14	21	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744936	"30 CHARLES ST, PARRAMATTA"	12	RES	68	63	58	48	Y	Y	70	79		2	7	12	22	14	22	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744903	"22 CHARLES ST, PARRAMATTA"	2	RES	68	63	58	48	Y	Y	74	83		6	11	16	26	18	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744902	"22 CHARLES ST, PARRAMATTA"	1	RES	68	63	58	48	Y	Y	74	83		6	11	16	26	18	26	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744901	"22 CHARLES ST, PARRAMATTA"	4	RES	68	63	58	48	Y	Y	73	82		5	10	15	25	17	25	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744900	"22 CHARLES ST, PARRAMATTA"	3	RES	68	63	58	48	Y	Y	73	83		5	10	15	25	18	25	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA03	744899	"22 CHARLES ST, PARRAMATTA"	10	RES	68	63	58	48	Y	Y	70	79		2	7	12	22	14	22	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744898	"22 CHARLES ST, PARRAMATTA"	9	RES	68	63	58	48	Y	Y	70	80		2	7	12	22	15	22	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744897	"22 CHARLES ST, PARRAMATTA"	8	RES	68	63	58	48	Y	Y	71	80		3	8	13	23	15	23	Noticable	Noticable	Clearly Audible	Moderately Intrusive

NCA03	744896	"22 CHARLES ST, PARRAMATTA"	7	RES	68	63	58	48	Y	Y	71	81		3	8	13	23	16	23	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744895	"22 CHARLES ST, PARRAMATTA"	6	RES	68	63	58	48	Y	Y	72	81		4	9	14	24	16	24	Noticable	Noticable	Clearly Audible	Moderately Intrusive
NCA03	744894	"22 CHARLES ST, PARRAMATTA"	5	RES	68	63	58	48	Y	Y	72	82		4	9	14	24	17	24	Noticable	Noticable	Clearly Audible	Moderately Intrusive

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact
NCA03	746686	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746685	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746684	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746683	"91 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746163	"150 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746162	"150 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746161	"150 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746160	"150 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746159	"150 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746113	"140 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746007	"95-101 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746006	"95-101 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746005	"95-101 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746004	"95-101 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	746003	"95-101 GEORGE ST, PARRAMATTA"	COM	Cosmetic
NCA03	746002	"95-101 GEORGE ST, PARRAMATTA"	COM	Cosmetic
NCA03	745591	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745590	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745589	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745588	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Human Comfort
NCA03	745587	"LEVEL 2 93 GEORGE ST, PARRAMATTA"	COM	Cosmetic

Attachment 14 – Consultation Summary

On Wednesdays 17th and 24th May 2023, the Project Team undertook doorknocking ad phone calls at the following properties:

<table>
<tr><th>Property address</th><th>Receiver Category</th><th>Impact Category</th><th>Feedback/Notes</th></tr>
<tr><td>30 Charles Street / 178 George Street</td><td>Residential</td><td>Highly Intrusive</td><td>Called / emailed building manager.

Follow up message sent 09/06/2023.

Follow up email sent 21/06/2023.

23/06/2023 voice message left for building manager.

Follow up email sent 29/06/2023.

Riva apartments

Block C – 30 Charles St Parramatta – units per level

<table>
<tr><td>Ground</td><td>1</td></tr>
<tr><td>1st</td><td>8</td></tr>
<tr><td>2nd</td><td>15</td></tr>
<tr><td>4th</td><td>15</td></tr>
<tr><td>6th</td><td>15</td></tr>
<tr><td>8th</td><td>15</td></tr>
<tr><td>10th</td><td>12</td></tr>
<tr><td>Total</td><td>81</td></tr>
<tr><td></td><td></td></tr>
</table>

Block B – 178 George St Parramatta – units per level</td></tr>
</table>

			<table><tr><td>Ground</td><td>10</td></tr><tr><td>1st</td><td>3</td></tr><tr><td>2nd</td><td>10</td></tr><tr><td>3rd</td><td>4</td></tr><tr><td>4th</td><td>10</td></tr><tr><td>5th</td><td>4</td></tr><tr><td>6th</td><td>10</td></tr><tr><td>7th</td><td>4</td></tr><tr><td>8th</td><td>8</td></tr><tr><td>9th</td><td>1</td></tr><tr><td>10th</td><td>6</td></tr><tr><td>11th `</td><td>1</td></tr><tr><td>Total</td><td>71</td></tr></table> Follow up email sent 21/07/2023 asking for information on front facing units. If request for specific mitigation measures is received post endorsement of this DNVIS, they will be implemented as required by MCoA D43 and D44.
22 Charles Street	Residential	Moderately Intrusive	Called and left a message 31/05/2023. Message left 02/06/2023— incoming call 07/06/2023. Email sent 07/06/2023. Building manager to share plans. Follow up message sent 09/06/2023. Voice message left 21/06/2023.

			Follow up email sent 21/06/2023. 23/06/2023 landline called. No pickup. SMS sent to building manager requesting call back. SMS message 21/07/2023 requesting information on front facing units if possible If request for specific mitigation measures is received post endorsement of this DNVIS, they will be implemented as required by MCoA D43 and D44.
6-10 Charles Street	Residential	Clearly Audible	Mix used building – commercial on ground level, residential above. Informed the building manager of the works and the potential impacts. Informed him that we are finalising our noise models and will be in touch with him when we have more specific information to share – he acknowledged the information and didn't have any other immediate concerns to raise. Floor plans provided. Level 11 = 7. Level 12 = 7. No level 13. Level 14 = 7. Level 15 = 4. No level 16.
20 Charles Street	Commercial	Clearly Audible	Commercial. Police on level 4 - they are the only tenant that uses the property in the evening.
67-69 Phillip Street	Commercial	-	Called. Provided information on works. No concerns, if power and other utility

			services are maintained. Will call if any issues arise.
91 Phillip Street	Commercial	-	No immediate concerns regarding works. Would like a copy of the notification closer to the date.
96 Phillip Street	Commercial	Clearly Audible	No immediate concerns. Wants email with details closer to the date. Commercial building. Only ground-floor tenants (restaurants) facing the river are present past 6 pm.
105 Phillip Street	Commercial	-	No concerns
115 Phillip Street	Commercial	-	Does not have any concerns. Would like an email update closer to work commencing.
73 George Street (Roxy Arcade)	Commercial	Clearly Audible	Does not have any concerns. Would like an email update closer to work commencing.
79 George Street	Commercial	Clearly Audible	No immediate concerns. Most occupants leave by 6pm, some may work late. Would like a email with details closer to work commencing.
80 George Street	Commercial	Clearly Audible	No issues. The building is usually vacant by 5.30 PM. Would like email update closer to work commencing.
81 George Street	Commercial	-	Called. Provided information on works. No concerns. Will call if any issues arise.
83 George Street	Commercial	Clearly Audible	Called. Provided information on works. No concerns. Will call if any issues arise.
85 George Street	Commercial	Clearly Audible	Called. Provided information on works. No concerns. Will call if any issues arise.

87-89 George Street	Commercial	Clearly Audible	Called. Provided information on works. No concerns. Will call if any issues arise.
91 George Street	Commercial	Clearly Audible	Called. Provided information on works. No concerns as long as access is maintained to the building, as some workers work late. Wants an email close to the date as a reminder / more specific info. Will call if any issues arise
93 George Street	Commercial	Clearly Audible	Called. Provided information about words. No concerns. Would like more specific info re dates closer to work taking place. Some staff work up to 8pm.
94 George Street	Commercial	Clearly Audible	Called. Provided information on works. No concerns. Will call if any issues arise.
95-101 George Street	Commercial	Clearly Audible	Called and left a message 25/05/2023. Called and left a message 02/06/2023.
100 George Street	Commercial	Clearly Audible	Does not have any concerns. Would like an email update closer to work commencing.
107 George Street	Commercial	Clearly Audible	Does not have any concerns. Would like an email update closer to work commencing. 02/06/23 - Commercial property. Occupied by one tenant – PCYC. They have programs until 9 PM weekdays.
109-113 George Street	Residential	Clearly Audible	The property is a mix use commercial/residential building. The building manager is concerned about the impacts of noise on residents. Fears noise blankets and other mitigation measures against noise will not be effective for such a tall

			building. Informed him that we are finalising our noise models and will be in touch with him when we have more specific information to share – he acknowledged the information and didn't have any other immediate concerns to raise. Strata manager shared floor plans: 278 units total. Level 2 = 22. level 3 =20 Level 4 = 18 Level 5 = 18 Level 6 = 18 Level 7-20 = 13 each level
110 George Street	Commercial	Clearly Audible	No immediate concerns. Would like an email closer to work commencing.
130 George Street	Commercial	Noticeable	No immediate concerns. Would like an email closer to work commencing.
150 George Street	Commercial	Clearly Audible	No concerns. Commercial building – empty after 6.
1 Barrack Lane	Commercial	Clearly Audible	Called. Provided information on works. No concerns. Will call if any issues arise.
20 Smith Street	Commercial	Clearly Audible	No immediate concerns. The building is commercial, some tenants may still be 'coming in and out' at night, but mostly unoccupied past 6 pm. Informed him of works and potential impacts. Would like an email closer to work commencing.
35 Smith Street	Commercial	Noticeable	No immediate concerns. Would like an email closer to work commencing.

1 Horwood Place	Commercial	Noticeable	No concerns. The building is mostly empty after hours.
2 Horwood Place	Commercial	Noticeable	Called. Provided information on works. No concerns. Will call if any issues arise.
3 Horwood Place	Commercial	Noticeable	No concerns. The building is mostly empty after hours.

Overall, the response from the residents was positive with no additional mitigation measures identified.

Notifications via letterbox and E-blast was also distributed in a 200m radius around the Parramatta Construction site, which amounts to around 2000 letterboxes and 2362 stakeholders from the mailing list.