Appendix V

Noise and Vibration Impact Assessment

Sydney Metro West

Sydney Olympic Park Over and Adjacent Station Development Noise and Vibration Impact Assessment

Appendix V

July 2022

NSW GOVERNMENT

sydney METRO

Document Number: SMWSTEDS-SMD-OLP-SN400-NV-RPT-044004

REVISION	DATE	SUITABILITY CODE	TEAMBINDER DOCUMENT NUMBER	TB REVISION
E	14/07/2022	S4	SMWSTEDS-SMD-OLP-SN400-NV-RPT-044004	E

Approval Record

FUNCTION	POSITION	NAME	DATE
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Amendment Record

DATE	REVISION	AMENDMENT DESCRIPTION	AUTHOR
17/12/2021	A	Initial issue	Akil Lau
25/02/2022	B	Second issue	Akil Lau
25/03/2022	C	Third issue	Akil Lau
14/04/2022	D	Final issue	Akil Lau
14/07/2022	E	Final issue with minor amendments	Michael Allan

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Glossary

Term	Definition
ABL	Assessment background level, the lowest 10th percentile of the background noise (the L_{A90}) over the defined period for each day
ANZEC	Australian and New Zealand Environment Council
ASD	Adjacent Station Development
AVATG	Assessing Vibration: A technical guideline
'A'-Weighted	Frequency adjustment to account for the relative loudness perceived by the human ear. Indicated by the units dB(A).
CBD	Central business district
CNVMP	Construction Noise and Vibration Management Plan
Concept and Stage 1 CSSI Approval	Application SSI-10038, including all major civil construction works between Westmead and The Bays, including station excavation and tunnelling, associated with the Sydney Metro West line
Concept SSD Application	A concept development application as defined in section 4.22 of the EP&A Act. It is a development application that sets out the concept for the development of a site, and for which detailed proposals for the site or for separate parts of the site are to be the subject of a subsequent development application or applications
'C'-Weighted	Frequency adjustment for noise measurements to account for loudness or bass noise. Indicated by the units dB(C).
dB	decibel, unit used to measure the loudness of sound
dB(A)	'A'-weighted decibel
DCP	Development Control Plan
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EPA	NSW Environment Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPI	Environmental planning instrument
GFA	Gross floor area
ICNG	Interim Construction Noise Guideline
IGU	Insulated glass unit
L_{A1}	The noise level which is exceeded for 1% of the measurement period.
L_{A10}	The noise level which is exceeded for 10% of the measurement period.
L_{A90}	The noise level which is exceeded for 90% of the measurement period, commonly used to indicate the background noise level.
$L_{Aeq,T}$	The energy average noise level over the measurement period, T
L_{AFmax}	The maximum noise level over the measurement period. This level is the maximum noise level due to an individual noise event.
NCA	Noise catchment area
NML	Noise management level(s)
NPfI	Noise Policy for Industry
OSD	Over Station Development

Term	Definition
RBL	Rating background level, the median ABL over an entire noise monitoring period
RNP	Road Noise Policy
SEARs	Secretary's Environmental Assessment Requirements
SEP	Special Entertainment Precinct
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
Stage 2 CSSI Approval	Application SSI-19238057, including major civil construction works between The Bays and Hunter Street Station
Stage 3 CSSI Application	Application SSI-22765520, including rail infrastructure, stations, precincts and operation of the Sydney Metro West line
Sydney Metro West	Construction and operation of a metro rail line and associated stations between Westmead and the Sydney CBD, as described in section 1.1
TfNSW	Transport for New South Wales
The site	The site which is the subject of the Concept SSDA
VDV	Vibration Dose Value(s)

Executive summary

This Noise and Vibration report supports a Concept State Significant Development Application (Concept SSDA) submitted to the Department of Planning and Environment (DPE) pursuant to part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Concept SSDA is made under section 4.22 of the EP&A Act.

Sydney Metro is seeking to secure concept approval for an over station development (OSD) and adjacent station development (ASD) on an area defined as Site 47 within the Central Precinct of Sydney Olympic Park (referred collectively as the 'proposed development'). The proposed development will comprise of one new commercial and retail building (Building 1) above the Sydney Olympic Park metro station and two residential accommodation buildings (Buildings 2 and 3) with retail and commercial space, adjacent to the Sydney Olympic Park metro station.

The Concept SSDA seeks consent for a building envelope and mixed-use purposes, maximum building height, a maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of development.

The Noise and Vibration Assessment Report provides an assessment of operational and construction acoustic impacts from the project to neighbouring land uses as well as the impact to the proposed development from environmental sources (e.g. road traffic and rail).

A construction noise and vibration impact assessment has been completed based on three construction scenarios. Minor construction noise impacts were predicted at nearby residential sensitive users (e.g. Pavilion Apartments). These impacts would need to be managed throughout construction phase of the project. Typical noise and vibration mitigation measures have been provided to manage and ameliorate the predicted impacts. Construction noise and vibration impacts would be considered in more detail in the contractors Construction Noise and Vibration Management Plan.

Operational noise and vibration impacts from the mechanical plant have been considered and it is anticipated that typical mitigation measures will be able to achieve compliance with the assessment criteria. Indicative design solutions have been provided based on preliminary assessment of the mechanical plant and general advice that is considered appropriate for projects of this type. Road traffic impacts in and surrounding the developments are not finalised at this stage but the location of car parking and loading docks underground, and a negligible increase in basement car parking over the site indicates that traffic noise impacts are not likely to exceed the assessment criteria. Indicative glazing construction are provided for the proposed development for traffic noise intrusion. The acoustic façade glazing requirements can be refined as the design develops.

With reference to Sydney Olympic Park Noise Management Guidelines, there are suggestions to minimise acoustic impacts of sporting and entertainment events on the land uses around these venues. Based on the worst-case scenario of high noise events within the sporting/entertainment venues in Sydney Olympic Park, the proposed development will require "substantial to some" noise mitigations for the external façade. It is anticipated that track form design will mitigate ground-borne, and structure borne vibration from Sydney Metro rail. A Detailed SSDA is to be made after the Concept SSDA, to seek consent for the design and to physically carry out the proposal. A detailed noise and vibration assessment report will form part of the future Detailed SSDA.

1 Introduction

1.1 Sydney Metro West

Sydney Metro West will double rail capacity between Greater Parramatta and the Sydney Central Business District (CBD), transforming Sydney for generations to come. The once in a century infrastructure investment will have a target travel time of about 20 minutes between Parramatta and the Sydney CBD, link new communities to rail services and support employment growth and housing supply.

Stations have been confirmed at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street (Sydney CBD).

Sydney Metro West station locations are shown in Figure 1-1.

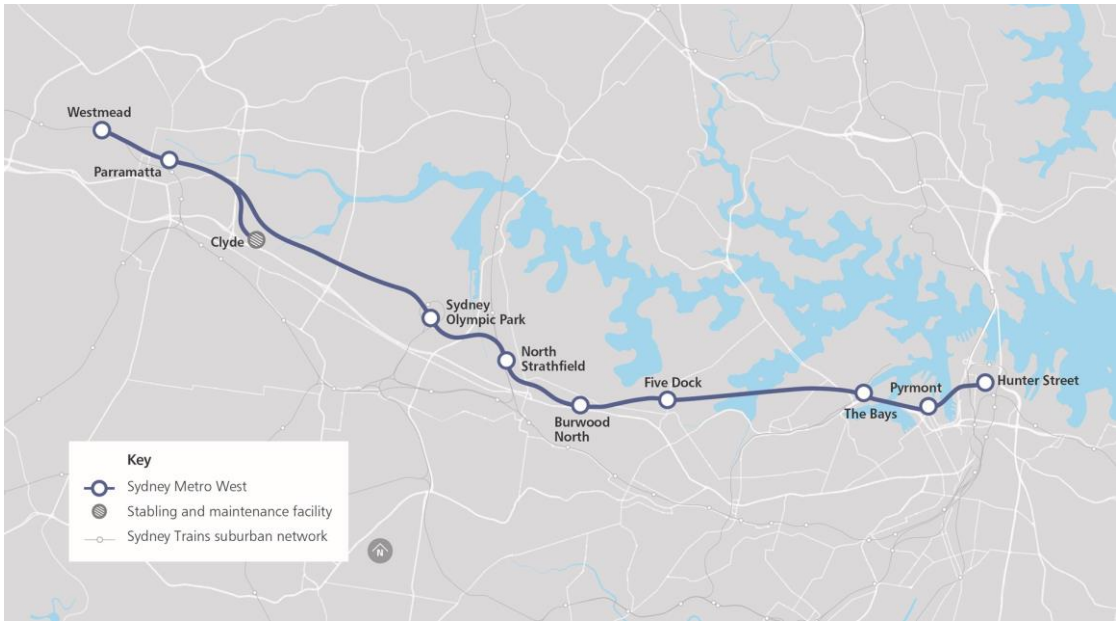

Figure 1-1 Sydney Metro West

1.2 Background and planning context

Sydney Metro is seeking to deliver Sydney Olympic Park metro station under a two-part planning approval process. The station fit-out infrastructure is to be delivered under a Critical State Significant Infrastructure (CSSI) application subject to provisions under division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), while the over and adjacent station developments are to be delivered under a State Significant Development (SSD) subject to the provisions of part 4 of the EP&A Act.

1.2.1 Critical State Significant Infrastructure

The State Significant Infrastructure (SSI) planning approval process for the Sydney Metro West metro line, including delivery of station infrastructure, has been broken down into a number of planning application stages, comprising the following:

- Concept and Stage 1 CSSI Approval (SSI-10038) – All major civil construction works between Westmead and The Bays including station excavation, tunnelling and demolition of existing buildings (approved 11 March 2021).

- Stage 2 CSSI Application (SSI-19238057) – All major civil construction works between The Bays and Hunter Street Station (under assessment).
- Stage 3 CSSI Application (SSI-22765520) – Tunnel fit-out, construction of stations, ancillary facilities and station precincts between Westmead and Hunter Street Station, and operation and maintenance of the Sydney Metro West line (under assessment).

1.2.2 State Significant Development Application

The SSD will be undertaken as a staged development with the subject Concept State Significant Development Application (Concept SSDA) being consistent with the meaning under section 4.22 of the EP&A Act and seeking conceptual approval for a building envelope, land uses, maximum building heights, a maximum gross floor area, pedestrian and vehicle access, vertical circulation arrangements and associated car parking. A subsequent Detailed SSD/s is to be prepared by a future development partner which will seek consent for detailed design and construction of the development.

1.3 Purpose of the report

This Noise and Vibration Impact Assessment report supports a Concept SSDA submitted to the Department of Planning and Environment (DPE) pursuant to part 4 of the EP&A Act. The Concept SSDA is made under section 4.22 of the EP&A Act.

This report has been prepared to specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the Concept SSDA on 18 February 2022 which states that the environmental impact statement (EIS) is to address the following requirements:

SEARs requirement	Where addressed in report
1. Statutory and strategic context • Address all relevant legislation, environmental planning instruments (EPIs) (including drafts), plans, policies and guidelines. • Identify compliance with applicable development standards and provide a detailed justification for any non-compliances. • If the development is only partly SSD declared under clause 8(1) of the State Environmental Planning Policy (SEPP) (Planning Systems) 2021 (previously SEPP State and Regional Development), provide an example of how the remainder of the development is sufficiently related to the component that is SSD.	Relevant legislation and guidelines presented in section 4.2
11. Noise and vibration • Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed manage and mitigation measures that would be implemented.	Covered throughout this report
22. Construction, operation and staging	Construction mitigation measures discussed in Section 4.5.

SEARs requirement	Where addressed in report
• If staging is proposed, provide details of how construction and operation would be managed and any impacts mitigated.	

This Noise and Vibration Impact Assessment report assesses the acoustic impact from the proposed development at the nearest sensitive receivers. It also assesses the impact from the environmental factors such as road and rail traffic on the proposed development. Predicted acoustic impacts are then assessed against the stipulated local and international guidelines and standards. Feasible mitigation measures are provided to reduce the impact and ensure to contain any adverse effect of noise and vibration due to the proposed project.

2 The site and proposal

2.1 Site location and description

The site is located within Sydney Olympic Park and is situated within the City of Parramatta Local Government Area. The site is in the Central Precinct of Sydney Olympic Park and defined as Site 47 in the Proposed SOP Master Plan (Interim Metro Review). The broader metro site is bound by Herb Elliot Avenue to the north, Olympic Boulevard to the west and Figtree Drive to the south as shown in Figure 2-1.

Figure 2-1 Sydney Olympic Park metro station location precinct

As described in Table 2-1, the site comprises part of Lot 59 in DP 786296 and Lot 58 in DP 786296, and comprises approximately 11,407m^2 of land.

Table 2-1 Site legal description

Street address	Legal description
5 Figtree Drive, Sydney Olympic Park	Lot 58 in DP 786296
7 Figtree Drive, Sydney Olympic Park	Lot 59 in DP 786296

2.2 Overview of this proposal

The Concept SSDA will seek consent for three building envelopes and the delivery of Precinct Street A as detailed in Table 2-2 and Figure 2-2.

Table 2-2 Sydney Olympic Park proposed development overview

Item	Description
Land use	**Building 1:** Commercial and retail **Building 2:** Commercial, retail and residential **Building 3:** Commercial, retail and residential
Building height (RL) / Number of storeys	**Building 1:** 120.20 / 21 storeys **Building 2**: 116.90 / 27 storeys **Building 3:** 171.50 / 45 storeys
Gross floor area (m^2)	**Building 1:** 28,517 **Building 2:** 12,089 **Building 3:** 27,384 **TOTAL: 68,000**
Car parking spaces	358

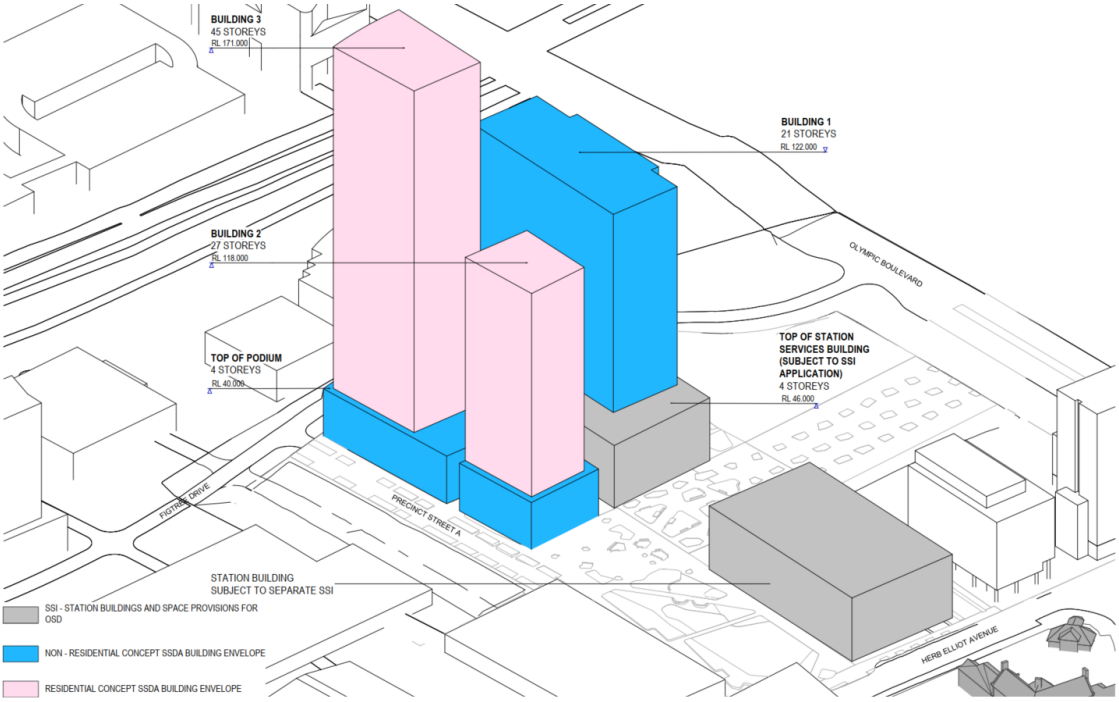

Figure 2-2 Proposed Concept SSDA development and CSSI scope

3 Scope of assessment

A noise and vibration impact assessment has been undertaken to determine the likely impacts on nearby sensitive receivers. The assessment includes:

- Review the existing environment and identify noise and vibration sensitive receivers throughout the project area.
- Determine the existing background noise levels based on previously undertaken ambient noise monitoring.
- Based on the noise logging results and local noise environments, determine applicable noise catchment areas for the assessment of noise impacts.
- Establishing representative construction scenarios, locations, working times and duration of activities that would apply to construction of the proposal.
- Establishing vibration levels within the proposed development due to impacts from existing underground rail operations.
- Establishing residential noise criteria for various event modes in accordance with Sydney Olympic Park Noise Management Guidelines.
- Predicting noise levels at receivers within the assessment area due to the proposed construction activities using a noise prediction model.
- Assessing potential construction noise impacts with reference to the Interim Construction Noise Guideline and the Sydney Metro Construction Noise and Vibration Standard.
- Assess road noise impacts from construction activities in accordance with the NSW EPA's Road Noise Policy (RNP).
- Assessing potential construction vibration impacts from the project in accordance with NSW EPA's Assessing vibration: a technical guideline.
- Assess potential operational noise impacts with reference to the Noise Policy for Industry (NPfI) and the RNP, where applicable.
- Identifying suitable management and mitigation measures to minimise the predicted noise and vibration impacts generated by the project. A detailed noise and vibration assessment report will form part of the detailed SSDA.

Future development

DPE is reviewing the 2016 Night Time Economy Round Table Action Plan and the trial of Special Entertainment Precincts (SEP). While it is early days regarding when this strategy would proceed, it will likely have requirements to ensure that new developments built in these SEPs are fit-for-purpose. Given the current stadium infrastructure in the area, it can reasonably be expected that Olympic Park will be designated an SEP. Any future development including the OSD would be subject to higher acoustic performance of the outer façade including external glazing.

4 Assessment

4.1 Existing noise and vibration environment

4.1.1 Existing noise environment

Noise sensitive receivers surrounding the site are similar distances away from any major roads or other noise emitting sources. While the background noise environment is relatively consistent throughout the project area, two noise catchment areas (NCA) have been defined. Ambient noise levels are controlled from Australia Avenue and Olympic Park Boulevard, arterial roads through the area. The catchment areas are defined as NCA 1 and NCA 2 (Australia Avenue), this separates the site based on each receiver area's proximity to the two main roads near to the site.

A site map identifying the NCAs and nearest noise sensitive receiver locations is provided in Figure 4-1.

NCA 1 comprises predominantly of commercial users and a few hotels. The nearest residential receiver to the site is Boomerang Tower at 3 Olympic Boulevard. The group of hotels are situated towards the north-west of the site, the closest hotel to the site is the Pullman at Sydney Olympic Park at the corner of Olympic Boulevard and Herb Elliott Avenue. The remainder of the buildings are commercial users. There is a heritage property (Abattoir Heritage Precinct) at 10 Herb Elliott Avenue adjacent to the site which is being used by few sports associations as a commercial use. The noise environment within NCA 1 is considered urban and dominated by traffic noise from Olympic Boulevard and distant traffic noise from Homebush Bay Drive and Western Motorway.

NCA 2 is predominantly comprised of residential users and commercial with a small number of childcare and educational users within the NCA. The nearest residential receiver to the site is the Pavilions Apartment Towers at 2 Figtree Drive, Sydney Olympic Park. The nearest commercial receiver is directly adjacent the site at 3 Figtree Drive. The noise environment within NCA 2 is considered urban and dominated by traffic noise from Australia Avenue and distant traffic noise from Homebush Bay Drive and Western Motorway.

The noise environment around Sydney Olympic Park is occasionally impacted by event noise from Stadium Australia and the other nearby sporting venues and the Sydney Showgrounds. In the case of Stadium Australia these events comprise both sporting and music events.

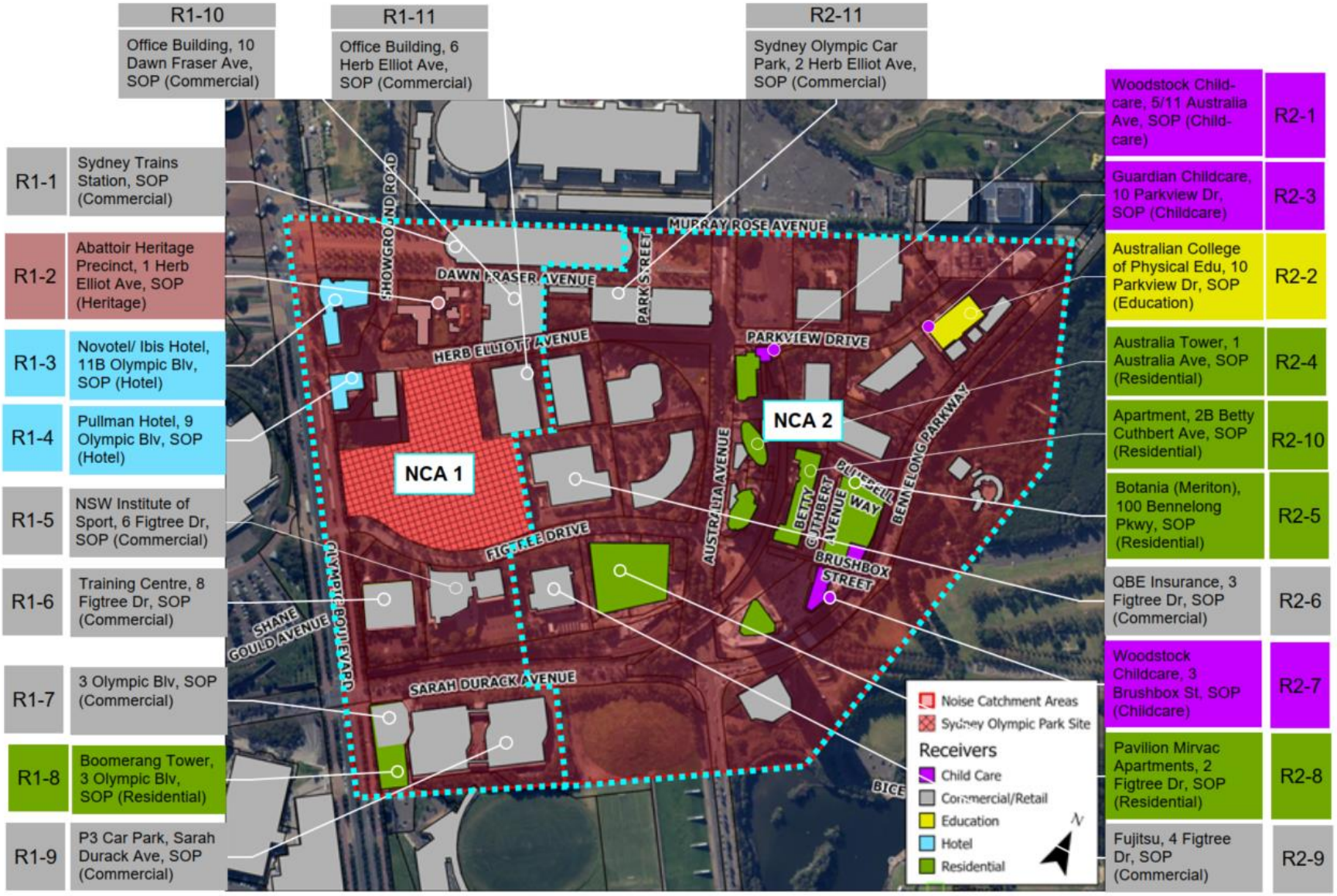

Figure 4-1 Site map identifying receiver types and noise catchment areas

4.1.2 Noise monitoring

Unattended noise monitoring

Baseline noise monitoring was undertaken as part of the Concept and Stage 1 CSSI Approval. The monitoring included ambient and background noise logging and was completed between March and July 2019.

A noise logger measures the local noise environment and records noise statistics about the measurement period. For this project the noise logger was setup to measure 15-minute intervals and record:

- L_{AFmax} – the maximum noise level over the measurement period. This level is the maximum noise due to an individual noise event.
- L_{A10} – the noise level which is exceeded for 10% of the measurement period.
- L_{Aeq} – the energy average noise level over the measurement period.
- L_{A90} – the noise level which is exceeded for 90% of the measurement period. This is considered to be the background noise level over the measurement period.

All measured noise levels are A-weighted, which is used across Australian and international standards to account for the relative loudness perceived by the human ear.

Further details of the weather and data processing can be found in the Sydney Metro West Environmental Impact Statement Westmead to The Bays and Sydney CBD Technical Paper 2 Noise and Vibration.

Figure 4-2 presents the noise monitoring locations in relation to the project site. Table 4-1 presents the summary of the noise logging results for the two locations. The measured noise levels have been used to define the intrusiveness noise criteria in accordance with the NPfI requirements.

The background noise environment throughout the area does not significantly change. Background noise is generally controlled from major transport infrastructure rather than local roads and minor arterials. The noise logger locations are generally considered representative, with daytime noise levels consistent and background noise driven during the quietest hours of the night and affected by individual passby movements.

The NPfI defines three separate assessment time periods: daytime (7am to 6pm); evening (6pm to 10pm); and night-time (10pm to 7am). For each time-period the assessment background level (ABL) has been established by determining the lowest 10th percentile of the background noise (the L_{A90}) over the defined period for each day. The rating background level (RBL) is the median ABL over the entire monitoring period.

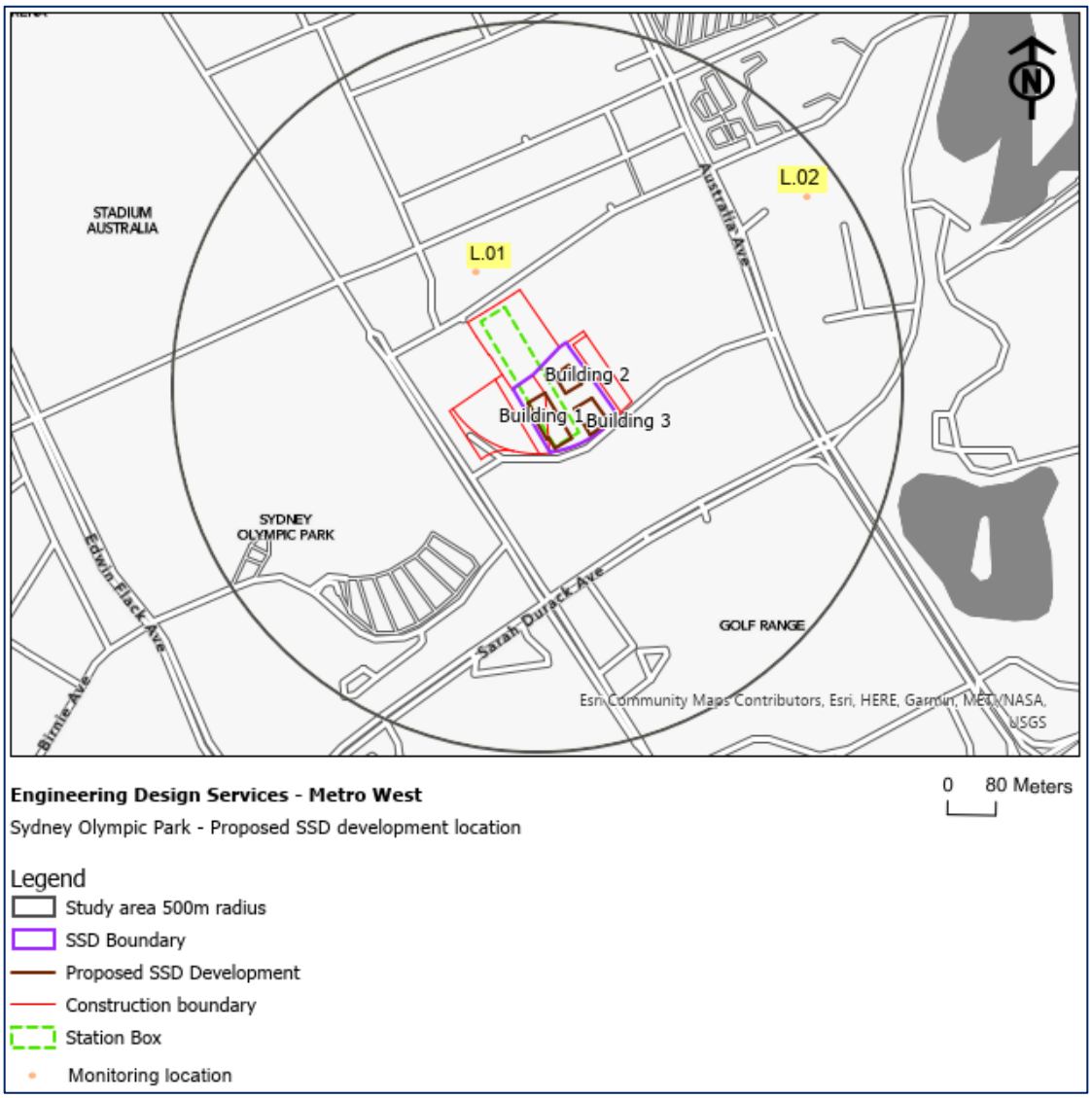

Figure 4-2 Unattended noise monitoring locations in relation to the Sydney Olympic Park site (includes SSDA)

Table 4-1 Unattended noise monitoring results

Location ID/NCA	Address	Background noise (RBL)			Average noise level (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L.01 (NCA 1)	1 Herb Elliot Avenue, Sydney Olympic Park	48	48	46	55	54	52
L.02 (NCA 2)	6 Parkview Drive, Sydney Olympic Park	48	46	41	57	58	53

Source: Sydney Metro West Environmental Impact Statement Westmead to The Bays and Sydney CBD Technical Paper 2 Noise and Vibration

Attended noise monitoring

Attended noise monitoring has not been undertaken as part of this assessment.

4.2 Assessment criteria

4.2.1 Construction noise

Table 4-2 summarises the different construction impacts that shall be assessed and the relevant guideline or document for establishing the appropriate criteria.

Table 4-2 Construction noise categories to be assessed

Impact type	Sub-category	Relevant guideline or document
Construction noise	Airborne noise emissions	Interim Construction Noise Guideline, Department of Environmental and Climate Change NSW, July 2009 (ICNG)
	Sleep disturbance	Interim Construction Noise Guideline, Department of Environmental and Climate Change NSW, July 2009 (ICNG) Noise Policy for Industry, NSW EPA, 2017 (NPfI)
	Ground-borne noise	Interim Construction Noise Guidelines, Department of Environmental and Climate Change NSW, July 2009 (ICNG)
	Road traffic noise	Noise Criteria Guideline, Roads and Maritime Services, (April 2015) Noise Mitigation Guideline, Roads and Maritime Services, (April 2015)
	Blasting	Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration, Australian and New Zealand Environment Council, (ANZEC 1990).

Note: The NSW EPA have released a Draft Construction Noise Guideline which will replace the ICNG when the draft guideline is finalised. The public consultation for the Draft Construction Noise Guideline closed in April 2021 with feedback currently under review. At the time of writing the ICNG is still applicable.

Airborne noise emissions

The ICNG provides guidance on the appropriate construction noise goals, in addition to identifying appropriate noise management and mitigation strategies. The Sydney Metro Construction Noise and Vibration Standard provides further, more detailed information on management and mitigation structures.

The ICNG also provide guidance on reasonable and feasible noise mitigation and management measures.

- Feasible - a mitigation or management measure is feasible if it is practical to build or capable of being put into practice given project constraints.
- Reasonable - a mitigation or management measure is reasonable if the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.

Residential land uses

Table 4-3 presents a summary of the residential noise management levels.

Table 4-3 Construction noise management level criteria – residential receivers

Time of day	Construction noise management level, $L_{Aeq,15min}$ [1]	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	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 75dB(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 (consent, determining or regulatory) 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 +5dB(A)	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 5dB(A) above the noise affected level, the proponent should negotiate with the community.

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

The applicable noise criteria for NCA1 and NCA2 have been defined based on noise loggers L.01 and L.02 respectively. Construction noise management levels are assessed at the property boundary that is most exposed to construction noise, and at a height of 1.5m above the floor height.

Table 4-4 provides a summary of the project's noise management levels (NMLs).

Table 4-4 Construction noise management levels – residential land uses

NCA	RBL, L_{A90} dB(A)			Noise management level, dB(A)		
	Day	Evening	Night	Day[1]	Evening[2]	Night[2]
NCA1	48	48	46	58	53	51
NCA2	48	46	41	58	51	46

Notes:
1. Daytime is assumed to fall within recommended standard construction hours and therefore RBL + 10dB(A) has been applied.
2. Evening and night-time fall outside of standard construction hours therefore RBL + 5dB(A) has been applied.

The ICNG was developed to protect different receiver types with typical constructions. In the Sydney Olympic Park area, the only nearby residential receiver is a multi-storey apartment building which incorporates upgraded glazing. This construction features a lower transmission of noise from outside to inside. It is considered reasonable to relax the construction noise goals, given the higher noise reduction provided by the façade. This assessment has included an assessment of the ICNG noise criteria, however a relaxation of 5dB should be considered to account for the façade construction.

Non-sensitive land uses

Noise management levels for non-sensitive land uses are provided in Table 4-5.

Table 4-5 Construction noise management levels – non-sensitive land uses

Land use	Noise management level, $L_{Aeq,15min}$
Industrial premises	External noise level 75dB(A)
Commercial premises (offices, retail outlets)	External noise level 70dB(A)

Sleep disturbance noise criteria

The ICNG requires a sleep disturbance noise assessment to be completed for construction works which are proposed for more than two consecutive nights.

The Sydney Metro West Construction Noise and Vibration Standard proposes an approach to assessing sleep disturbance events shall be consistent with the NPfI. Where night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater, a detailed maximum noise level event assessment is to be undertaken.

The detailed assessment is required to cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

Maximum noise level event assessments should be based on the L_{AFmax} descriptor on an event basis under 'fast' time response. The detailed assessment will consider all feasible and reasonable noise mitigation measures with the goal of achieving the above trigger levels for night-time activities. Table 4-6 summarises the sleep disturbance criteria for construction noise.

Table 4-6 Construction noise sleep disturbance criteria

NCA	Night-time RBL, L_{A90} dB(A)	Construction noise sleep disturbance criteria	
		$L_{Aeq,15min}$, dB(A)	L_{AFmax}, dB(A)
NCA 1	46	51	61
NCA 2	41	46	56

Ground-borne noise

Ground-borne noise levels for residents are nominated in the ICNG and indicate where management actions would be implemented. These levels are only applicable when ground-borne noise levels are higher than airborne noise levels. Any levels exceeding objectives should be considered in the context of any existing exposure to ground-borne noise.

The ground-borne noise management levels (residential receivers only) are:

- evening (6pm to 10pm) internal $L_{Aeq,15min}$ 40dB(A)
- night-time (10pm to 7am) internal $L_{Aeq,15min}$ 35dB(A).

These levels are assessed at the centre of the most affected habitable room.

Construction road traffic noise

Road traffic noise impacts associated with road project construction is not explicitly provided in the ICNG nor the NSW RNP. An approach similar to a traffic generating development has been taken. An initial assessment has been completed to determine the increase in traffic noise due to the project construction. Where this increase is 2dB(A) or less, no further assessment is required. Where the increase is greater than 2dB(A) and exceeds the road category specific criterion, a more detailed assessment is completed.

Further detail about applying the Road Noise Policy is included in Section 4.2.3.

4.2.2 Construction vibration

Table 4-7 summarises the construction vibration impacts that shall be assessed and the relevant guideline or document for establishing the appropriate criteria.

Table 4-7 Construction vibration categories to be assessed

Impact type	Sub-category	Relevant guideline or document
Construction vibration	Human comfort	Department of Environment and Conservation, Assessing Vibration: A technical guideline, February 2006. (AVATG)
	Structural damage	BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in Buildings Part 2

Human comfort

Perceptible vibration can be an annoyance to building occupants, particularly if the duration or frequency of events is significant. Vibration criteria are provided by AVATG and provides guidance in terms of continuous and impulsive vibration, and intermittent vibration. Vibration from construction activities associated with this project would be generally considered intermittent vibration.

Intermittent vibration

The intermittent vibration criteria provided by AVATG is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDVs for intermittent vibration are provided below in Table 4-8. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 4-8 Construction vibration - human comfort criteria - intermittent vibration

Land use	Vibration Dose Value (VDV) design goals ($m/s^{1.75}$)			
	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas (1)	0.10	0.20	0.10	0.20
Residences (2)	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:
1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.
2. Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

Continuous and impulsive vibration

Acceptable levels of human exposure to continuous and impulsive vibration are dependent on the time of day and the activity taking place in the occupied space. AVATG provides the preferred values for continuous and impulsive vibration. These are presented in Table 4-9.

Where vibration values are below the preferred values in Table 4-9, there is a low probability of adverse comment or disturbance to building occupants. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short duration. Vibration values above the preferred values in Table 4-9 may be dealt with through negotiation with the regulator and affected community.

Table 4-9 Construction vibration – human comfort criteria – continuous and impulsive vibration

Location	Assessment period	Peak Particle Velocity (PPV), mm/s	
		Preferred (z-axis)	Maximum (z-axis)
Continuous vibration			
Critical areas (1)	When in use	0.14	0.28
Residences (2)	Daytime	0.28	0.56
	Night-time	0.20	0.40
Offices, schools, educational institutions, and places of worship	When in use	0.56	1.1
Workshops	When in use	1.1	2.2
Impulsive vibration			
Critical areas (1)	When in use	0.14	0.28
Residences (2)	Daytime	8.6	17.0
	Night-time	2.8	5.6
Offices, schools, educational institutions, and places of worship	When in use	18.0	36.0
Workshops	When in use	18.0	36.0

Notes:
1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.
2. Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

Structural damage

Vibration transmitted through the ground may cause damage to structures and architectural elements or discomfort to their occupants. The vibration levels at which people become annoyed are well below vibration levels at which damage occurs. The likelihood of such damage or discomfort may be ascertained by measuring the vibration from a vibrational impact close to the location of concern such as a building or other structure.

Frequency-dependent guide levels described in British Standard BS 7385-2 and the AS 2187.2-2006 are given below. The levels specified are peak component particle velocities, and the methodologies used for assessing the frequencies, are similar in both documents. The frequency-dependent guide values provide PPV for the prevention of minor or cosmetic damage occurring in structures from ground vibration. The vibration levels presented in Table 4-10 are applicable to transient vibration.

Table 4-10 Transient vibration criteria for cosmetic damage (AS 2187.2 – 2006/ BS7385-2)

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

Note: Values referred to are at the base of the building

For continuous vibration which has the potential to generate resonance within structures these values are typically reduced by 50%. Common construction equipment such as rock-breaking and vibratory rollers are likely to generate resonances which would attract this penalty. Table 4-11 presented below are the vibration screening criteria which should be applied for all construction activities.

Table 4-11 Continuous vibration criteria for cosmetic damage (AS 2187.2-2006/ BS7385-2)

	Peak component particle velocity in frequency range of predominant pulse	
Type of building	**4 Hz to 15 Hz**	**15 Hz and above**
Reinforced or framed structures. Industrial and heavy commercial buildings	25 mm/s and 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type buildings	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above

4.2.3 Operational noise

Presented below in Table 4-12 is a summary of the potential operational noise impacts, and relevant documents which provide appropriate design noise goals.

Table 4-12 Summary of operational impact categories to be assessed

Impact type	Sub-category	Relevant guideline or document
Environmental noise emission	Airborne environmental noise emissions	NSW EPA, Noise Policy for Industry, October 2017
	Sleep disturbance	
	Emergency plant noise	
	Traffic generating development	NSW Road Noise Policy

Impact type	Sub-category	Relevant guideline or document
External noise intrusion	Airborne external noise intrusion	State Environmental Planning Policy (Transport and Infrastructure) 2021 NSW Development Near Rail Corridors and Busy Roads – Interim Guideline Australian / New Zealand Standard 2017:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS/NZS 2017:2016)
	Ground-borne noise	NSW Development near Rail Corridors and Busy Roads – Interim Guideline
Development Control Plan requirements		Parramatta Development Control Plan (DCP) 2011, City of Parramatta

Environmental noise emission

The NSW Noise Policy for Industry (NPfI) provides guidance on appropriate noise levels for external noise emissions from fixed facilities on surrounding sensitive receivers. The NPfI considers noise goals in terms of intrusiveness and amenity noise levels. The intrusiveness noise level protects against significant changes in noise, while the amenity noise level seeks to protect against cumulative noise impacts from industry. Together, these levels are used to assess the potential impact of noise and assess reasonable and feasible noise mitigation measures. Project noise trigger levels are developed through this process. They are not used directly as regulatory limits.

The NPfI requires a project to take consideration of other industrial noise sources in setting amenity noise objectives. In cases of a new development where there are no existing industrial sources, the NPfI accepts a default of the amenity noise level minus 5dB to take account of future industrial sources.

For the Metro West project, the SSD services noise will be assessed with the default amenity noise level minus 5dB adjustment to account for cumulative noise sources. The cumulative noise impact associated with the metro station and this project has not been assessed together as they will each meet an amenity noise level objective that allows for other industrial noise sources in the area. In the event that both projects use their entire amenity noise criteria, the combined noise impact would remain 2dB below amenity noise levels discussed below.

Intrusiveness base noise criteria

The intrusiveness noise level protects against significant changes in noise levels and is applicable to residential receivers only. The criterion is defined by the formula below:

$$L_{Aeq,15min} = rating\ background\ noise\ level + 5\ dB$$

The rating background level (RBL) is the average background noise level over a measurement period of at least one week, discussed previously in section 4.1.2.

Table 4-13 summarises the measured RBL and corresponding intrusiveness level for each time period.

Table 4-13 Operational noise intrusiveness levels – residential land uses only

NCA	Rating background level (RBL)			Intrusive noise level criteria, LAeq,15min dB(A)		
	Daytime	Evening	Night time	Daytime	Evening	Night time
NCA 1	48	48	46	53	53	51
NCA 2	48	46	41	53	51	46

Amenity base noise criteria

The amenity noise level seeks to protect against cumulative noise impacts from industry.

The NPfI uses project noise trigger levels measured over a 15-minute time period, assessed as an $L_{Aeq,15min}$. The night-time amenity noise criterion is the most stringent, hence the controlling time-period. To account for converting $L_{Aeq,period}$ to $L_{Aeq,15min}$, the NPfI accepts a default conversion factor of $L_{Aeq,15min} = L_{Aeq,period} + 3dB$.

To ensure industrial noise levels do not gradually increase with new developments, a minus 5dB(A) correction is applied to the amenity noise level. The amenity noise levels have been presented in Table 4-14.

Table 4-14 Operational noise amenity levels

Receiver	Noise amenity area	Time period	NPfI amenity noise level, $L_{Aeq,period}$ dB(A)	Adjusted amenity noise level[1], $L_{Aeq,15min}$ dB(A)
Residential	Rural	Day	50	48
		Evening	45	43
		Night	40	38
	Suburban	Day	55	53
		Evening	45	43
		Night	40	38
	Urban	Day	60	58
		Evening	50	48
		Night	45	43
Hotels, motels, caretakes quarters, holiday accommodation, permanent resident caravan parks	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day			
School classroom	Internal	Noisiest 1-hour period when in use	35	33(2)
Hospital ward	Internal	Noisiest 1-hour period	35	33
	External	Noisiest 1-hour period	50	48
Place of worship	Internal	When in use	40	38(2)

Receiver	Noise amenity area	Time period	NPfI amenity noise level, $L_{Aeq,period}$ dB(A)	Adjusted amenity noise level[1], $L_{Aeq,15min}$ dB(A)
Passive recreation area	All	When in use	50	48
Active recreation area	All	When in use	55	43
Commercial premises	All	When in use	65	63
Industrial premises	All	When in use	70	68
Industrial interface	All	All	Add 5dB(A) to the recommended noise amenity area	

Notes:
1. Adjusted level calculated by applying 5dB reduction to account for cumulative existing and future industrial noise sources and 3dB addition to adjust the amenity noise level from L_{Aeq} to $L_{Aeq,15min}$.
2. For assessment, 10dB can be added to the internal noise level criteria to assess the external noise level. This is generally accepted as the reduction provided by the façade with an open window.

Corrections for annoying noise characteristics

Table C1 of the NPfI provides corrections for tonality, intermittency, irregularity or dominant low-frequency content. These corrections are to be added to the measured or predicted noise levels at the receiver before comparison with the project noise trigger levels. NPfI also provides adjustments for duration that can increase the project noise criterion for unusual or one-off high-noise level events.

Low frequency noise correction

A difference of 15dB or more between the C- and A-weighted noise measurements, identifies the potential for an unbalanced spectrum and an increased likelihood of low frequency noise annoyance.

The difference between C- and A-weighted noise levels is typically used as a screening tool to determine if further investigation is required to determine potential annoyance (i.e. where the difference is 15dB or more). Where further investigation confirms significant low frequency content, a low frequency noise correction is applied to the predicted or measured noise levels.

The NPfI identifies that the corrections should “reflect external assessment locations”, or sensitive receiver locations so the existing noise environment should be considered.

At residential receiver locations (NCA 2) the existing ambient noise levels are 9dB, 12dB, and 12dB greater than the background noise during the daytime, evening and night-time period respectively. The design noise criteria will be below the existing ambient noise level so triggering of the low frequency noise criteria is unlikely.

Emergency plant noise

In the absence of any relevant NSW guideline for emergency generators and equipment, it is recommended that noise limits in Table 4-13 be relaxed by 5dB(A) for emergency plant equipment. Table 4-15 presents the emergency operations noise criteria.

Table 4-15 Emergency operations noise criteria – residential land uses

Receiver	Noise amenity area	Time period	NPfI Intrusiveness criteria, $L_{Aeq,15min}$ dB(A)	Emergency operations noise criteria, $L_{Aeq,15min}$ dB(A)
Residential	Urban	Day	53	58
		Evening	53	58
		Night	51	56

Sleep disturbance

The NPfI contains guidance on sleep disturbance and the following screening levels are used to identify where further investigation of sleep disturbance should be undertaken for residential properties (NCA 2):

- $L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.

This assessment has considered both the night-time $L_{Aeq,15min}$ noise levels and L_{AFmax} noise levels, where they are relevant. The sleep disturbance screening levels are presented in Table 4-16.

Table 4-16 Operational noise – sleep disturbance screening levels

NCA	Night-time RBL, L_{A90} dB(A)	Sleep disturbance screening levels, dB(A)	
		$L_{Aeq,15min}$	L_{AFmax}
NCA 1	46	51	61
NCA 2	41	46	56

Traffic generating development

Guidance for the assessment of noise from traffic movements to and from site, including truck and car movements, is provided by the NSW RNP.

Table 4-17 presents the RNP road traffic noise assessment criteria for residential/commercial land use developments with potential to create additional traffic on existing roads. The external noise criterion is assessed at 1 metre from the affected residential building facades and at a height of 1.5 metres above the ground or floor level.

In cases where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2dB represents a minor impact that is considered barely perceptible to the average person.

Table 4-17 Operational noise assessment criteria – traffic generating development

Road category	Type of project/ land use	Assessment criteria, dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway / arterial / sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hr)}$ 60 (external)	$L_{Aeq,(9hr)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hr)}$ 55 (external)	$L_{Aeq,(1hr)}$ 50 (external)

External noise intrusion

Residential land uses

The State Environmental Planning Policy (Transport and Infrastructure) 2021 provides guidelines to ensure that the development of new residential buildings protects occupants adequately from noise associated with existing road and railway infrastructure.

The key clauses related to rail corridors are:

> *Clause 2.99 (1) This section applies to development for any of the following purposes that is on and in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration -:*
>
> *a) Residential accommodation,*
>
> *b) Place of public worship,*
>
> *c) A hospital,*
>
> *d) An educational establishment or centre-based childcare facility.*
>
> *Clause 2.99 (2) Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this section and published in the Gazette:*
>
> *For clauses 2.99 (3) If the development is for the purpose of a building for residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded - be satisfied that appropriate measure will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> *a) In any bedroom in the residential accommodation: 35dB(A) at any time 10pm-7am*
>
> *b) Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time.*

Non-residential land uses

All internal areas shall be designed to mitigate external noise intrusion to the recommended internal noise criteria based upon their use contained within AS/NZS

2107:2016 “Acoustics – Recommended design sound levels and reverberation times for building interiors”.

Combined internal noise levels due to external noise intrusion and internal mechanical services such as air conditioning and mechanical ventilation plant should not exceed the upper level of the range recommended in AS/NZS 2107:2016.

Internal noise levels due to road traffic noise intrusion should be controlled to meet AS/NZS 2107:2016 recommended design sound levels less 3dB. This allows for an equal contribution from mechanical services noise sources within the development.

Table 4-18 External noise intrusion – non-residential land uses

Type of occupancy/activity	Design sound level range $L_{Aeq,T}$
Educational Buildings - Lecture rooms up to 50 seats - Teaching spaces/single classroom – open plan teaching space	 30 to 35 35 to 45
Health Buildings - Consulting rooms	 40 to 45
Office Buildings - General office areas	 40 to 45
Hotels and Motels in inner city areas or entertainment districts or near major roads - Sleeping areas (night-time)	 35 to 40
Small Retail Stores (General)	<50

Ground-borne noise

Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present where airborne noise does not provide a masking effect. The NSW Development near Rail Corridors and Busy Roads – Interim Guideline specifies a night-time residential noise criterion of $L_{Amax,slow}$ 35dB(A) is required to be complied with for 95 percent of train passbys.

Ground-borne vibration

The NSW Development near Rail Corridors and Busy Roads – Interim Guideline specifies vibration criteria listed in the Assessing vibration: a technical guideline (AVATG) for appropriate vibration goals for continuous, impulsive, and intermittent vibration. These criteria have been defined in Table 4-19.

Table 4-19 Operational vibration – human comfort criteria – intermittent vibration

Land use	Vibration Dose Value (VDV) design goals (m/s$^{1.75}$)			
	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
Critical areas (1)	0.10	0.20	0.10	0.20
Residences (2)	0.20	0.40	0.13	0.26
Offices, schools, educational institutions, and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes:
1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria.
2. Criteria for residences are lower than schools as people expect to be able to relax/sleep in their homes without annoyance and are generally more concerned about structural damage than would be the case within schools and offices.

Development control plan requirements

The Parramatta LGA does not have specific DCP requirements relating to noise and vibration. The Sydney Olympic Park Authority (SOPA) requirements are mentioned below.

Acoustic suitability for Residential Development

The Proposed Sydney Olympic Park Master Plan 2030 (Interim Metro Review) provides guidance for proposed development within the Sydney Olympic Park "the Park". Under the *Sydney Olympic Park Authority Act 2001*, SOPA is required to maintain and update the Master Plan. The primary focus of these guidelines is to minimise potential acoustic impacts of sporting and entertainment venues on other land uses within and around the park. Table 4-20 provides guidance on the amount of external façade treatment required for residential buildings due to noise from sporting/ entertainment events.

Buildings 2 and 3 which are residential towers are 27 and 45 storeys respectively. In accordance with Sydney Olympic Park Noise Management Guidelines, the residential towers will be subject to "substantial to some" noise mitigation measures. A more thorough analysis will be undertaken in the detailed design phase.

Table 4-20 Residential noise criteria for each noise type and contour levels

Noise type	Source of Criterion	Noise Measure	External Criterion[5]	Some mitigation required	Substantial mitigation required	Maximum mitigation required	Not suitable for Residential Development
Sports & Concerts	SOP Guidelines[1]	L_{Amax}	60dBA	>60dBA	>70dBA	>80dBA	>85dBA
Late Night Parties	SOP Guidelines[1]	$L_{eq,\ 125Hz,\ 15min}$	50dB	>50dBA	>60dBA	>70dBA	>75dBA
Industrial	Noise Policy for Industry[2]	$L_{Aeq,\ 15mins}$	45dBA	>45dBA	>55dBA	>65dBA	>70dBA
Carnival Area	Development Consent	$L_{A10,\ 15mins}$	45dBA	>45dBA	>55dBA	>65dBA	>70dBA
Road traffic	Road Noise Policy[3]	$L_{Aeq,\ 9hr\ (10pm\ to\ 7am)}$	50dBA	>50dBA	>60dBA	>70dBA	>75dBA
Rail traffic	Department of Planning[4]	$L_{Aeq,\ 9hr\ (10pm\ to\ 7am)}$	45dBA	>45dBA	>55dBA	>65dBA	>70dBA

Note:
1. Sydney Olympic Park Noise Management Guidelines, Report No. 99053, July 2002.
2. Night-time amenity criterion for 'Urban' areas, NSW Noise Policy for Industry, EPA.
3. NSW Road Noise Policy, EPA (formerly the Environmental Criteria for Road Traffic Noise).
4. Development Near Rail Corridors and Busy Roads – Interim Guideline, NSW Department of Planning.
5. The equivalent internal noise criterion is 10dBA below the external criterion, 10dBA being the typical attenuation of an open window.

4.3 Impact assessment

4.3.1 Construction noise and vibration impacts

Construction stages and scheduling

Construction works are outlined in Table 4-21 have been grouped into two indicative construction stages.

It is assumed that demolition, site establishment and excavations would be conducted as part of the Concept and Stage 1 CSSI Approval, and Stage 3 CSSI Application.

Table 4-21 Construction stages and scheduling (SSDA)

Construction scenario	Construction hours
1. Building 1 Commercial building above the crash deck	Day – Standard hours
2a. Residential Buildings 2 and 3 and the commercial/retail podiums below	Day – Standard hours
2b. Residential Buildings 2 and 3 and the commercial/retail tower	Day – Standard hours

Detailed construction scenarios are to be established in the Construction Noise and Vibration Management Plan when more detail is available about the program of works including construction staging, likely construction scenarios, equipment types and locations, noise and vibration source levels, and hours of work.

Staging

The construction of the proposed development at Sydney Olympic Park would be delivered using three possible staging scenarios:

- **Scenario 1 (Preferred):** proposed development construction would be completed prior to commencement of Sydney Olympic Park metro station operations.
- **Scenario 2:** proposed development construction would commence prior to Sydney Olympic Park metro station operations but completed after the station is operational.
- **Scenario 3:** proposed development construction would commence after Sydney Olympic Park metro station is operational.

This assessment has assessed the preferred option, Scenario 1.

Construction outside standard working hours

It is anticipated that the majority of construction works would be carried out during ICNG standard working hours. Any work undertaken outside of standard working hours will be in accordance with the Interim Construction Noise Guideline. While no specific out of hours work has been identified for this project, there are a range of activities which could occur on a major construction project such as:

- relocation of utilities
- the delivery of materials as required by the police or other authorities for safety reasons
- where it is required to avoid the loss of lives, property and/or to prevent environmental harm in an emergency
- works which are determined to comply with the relevant noise management level (NML) at the most affected sensitive receiver.

In addition, any construction work outside ICNG standard hours (including one or two nights of work) would require prior approval. This would include a noise impact assessment to determine the potential for sleep disturbance impacts and the identification of reasonable and feasible noise management and mitigation measures.

4.3.2 Plant and equipment noise levels

Presented below in Table 4-22 are typical sound power levels of the construction equipment used in this assessment as well as the cumulative level for each scenario. These sound power levels are typical levels taken from the data provided in Australian Standard AS 2436-2010 - Guide to noise and vibration control on construction, demolition and maintenance sites and the UK Department for Environmental, Food and Rural Affairs Update of noise database for prediction of noise on construction and open sites noise database and assume equipment is modern and in good working order.

For the noise assessment, only the worst-case construction scenarios have been considered. The modelled scenario includes all equipment that could be reasonably assumed to be operating at the same time for an entire 15 minutes.

Table 4-22 Typical sound power levels of construction equipment

Phase	Equipment/activity	Qty	SWL dB(A)
Podium construction	Diesel tower cranes	2	99
	Electric concrete placing boom	1	103
	Electric formwork hoist	2	82
	Diesel Manitou at ground	1	92
	Forklift	1	101
	Delivery trucks of various sizes at ground	1	98
	Rubbish removal trucks at ground	1	98
	Diesel mobile cranes at ground	1	104
	Typical overall sound power level		109
Tower construction	Diesel tower cranes	2	99
	External man and material hoist	2	94
	Electric concrete placing boom	1	103
	Electric formwork hoist	2	82
	Diesel manitou at ground	1	92
	Forklift	1	101
	Delivery trucks of various sizes at ground	1	98
	Rubbish removal trucks at ground	1	98
	Diesel mobile cranes at ground	1	104
	Typical overall sound power level		110

Source: AS 2436-2010 and Department for Environmental, Food and Rural Affairs

4.3.3 Assessment methodology

To quantify noise emissions from the proposed construction works, environmental noise modelling software (SoundPLAN version 8.2) has been used to predict the $L_{Aeq(15min)}$ noise levels at nearby noise sensitive receivers.

The environmental noise model includes:

- ground terrain, sourced from Elvis Foundation Spatial Data
- building footprints, interpreted from SIX Maps aerial photography
- construction works area with the combined overall source noise levels of the anticipated equipment for each scenario.

The predicted construction noise levels are likely to be conservative as they assume a potential worst-case scenario where all equipment operates simultaneously and continuously for the entire 15-minute period. As such, noise levels are likely to be lower than the worst-case noise levels presented for most time periods during the works.

4.3.4 Construction site noise assessment

Noise levels have been predicted for the nominated construction scenarios. Predicted construction noise impacts for each construction phase are presented in Table 4-23. Noise contours are also provided in Appendix A of this report.

The nearest residential receiver is more than 100m from the construction works, so construction noise impacts are limited. An exceedance of less than 5dB has been predicted at the nearest residential receiver.

While no significant exceedances of the NMLs have been predicted, it is important that all feasible and reasonable noise management and mitigation measures are included in the contractors Construction Noise and Vibration Management Plan (CNVMP). Recommendations have been included in section 4.5.

4.3.5 Cumulative construction impacts

The proposed development is intended to follow the construction of the Sydney Olympic Park metro station. However, the integrated nature of the delivery of the proposed development and Sydney Olympic Park metro station may lead to concurrent construction of some components of the station and proposed development. A detailed construction itinerary would be developed by the site contractors for the proposed development which would include duration and timing of the construction. The cumulative predicted levels presented in Table 4-23 are all stages operating simultaneously. While unlikely that major construction noise would be generated on the podium and tower of the same building concurrently, this scenario has been included for conservatism.

While it is possible that other major projects in the vicinity have the potential to increase noise levels, realistically the greatest increase in noise that can be expected could be 3dB. While the increase in noise is not significant construction fatigue from projects running back-to-back have the potential to be a more significant issue. This would need to be managed by the contractors to minimise any potential impacts.

These impacts would be considered in more detail in the contractors CNVMP with the identification of appropriate noise management and mitigation measures to limit impacts on the surrounding community.

Table 4-23 Predicted standard construction hours noise impacts, dB(A)

ID	Address	Receiver type	NML[1]	Building 1 Tower		Building 2 & 3 Podium		Building 2 & 3 Tower		Cumulative	
				SPL	Exceedance	SPL	Exceedance	SPL	Exceedance	SPL	Exceedance
NCA 1											
R1-1	Sydney Olympic Park Train Station	Public	70	51	-	48	-	54	-	56	-
R1-2	Abattoir Heritage Precinct, 1 Herb Elliot Avenue	Heritage/ Commercial	70	55	-	55	-	59	-	60	-
R1-3	Novotel/ Ibis Hotel, 11B Olympic Boulevard	Hotel	63	48	-	47	-	53	-	54	-
R1-4	Pullman Hotel, 9 Olympic Boulevard	Hotel	63	56	-	52	-	58	-	59	-
R1-5	NSW Institute of Sport, 6 Figtree Drive	Commercial	70	65	-	62	-	67	-	69	-
R1-6	Training Centre, 8 Figtree Drive	Commercial	70	61	-	54	-	62	-	64	-
R1-7	3 Olympic Boulevard	Commercial	70	51	-	48	-	54	-	55	-
R1-8	Boomerang Tower, 3 Olympic Boulevard	Residential	58	48	-	45	-	51	-	52	-
R1-9	P3 Car Park, Sarah Durack Avenue	Commercial	70	47	-	44	-	50	-	51	-
R1-10	Office Building, 10 Dawn Fraser Avenue	Commercial	70	54	-	51	-	57	-	58	-
R1-11	Office Building, 6 Herb Elliot Avenue	Commercial	70	59	-	59	-	64	-	65	-
R1-12	Office Building, 10 Herb Elliot Avenue	Commercial	70	58	-	55	-	61	-	62	-

ID	Address	Receiver type	NML[1]	Building 1 Tower		Building 2 & 3 Podium		Building 2 & 3 Tower		Cumulative	
				SPL	Exceedance	SPL	Exceedance	SPL	Exceedance	SPL	Exceedance
NCA 2											
R2-1	Woodstock Childcare, 5/11 Australia Avenue	Childcare	60	35	-	33	-	40	-	41	-
R2-2	Australian College of Physical Education, 10 Parkview Drive	Education	60	33	-	29	-	38	-	39	-
R2-3	Guardian Childcare, 10 Parkview Drive	Childcare	60	33	-	29	-	38	-	39	-
R2-4	Australia Tower, 1 Australia Avenue	Residential	58	47	-	47	-	51	-	53	-
R2-5	Botania (Meriton), 100 Bennelong Parkway	Residential	58	43	-	41	-	48	-	49	-
R2-6	QBE Insurance, 3 Figtree Drive	Commercial	70	59	-	60	-	64	-	65	-
R2-7	Woodstock Childcare, 3 Brushbox Street	Childcare	60	36	-	30	-	43	-	44	-
R2-8	Pavilion Apartments, 2 Figtree Drive	Residential	58	55	-	53	-	59	1	60	2
R2-9	Fujitsu, 4 Figtree Drive	Commercial	70	57	-	58	-	62	-	63	-
R2-10	Apartment Building, 2B Betty Cuthbert Avenue	Residential	58	45	-	44	-	49	-	51	-
R2-11	Sydney Olympic Car Park, 2 Herb Elliot Avenue	Commercial	70	45	-	42	-	52	-	52	-

[1]A 15dB internal to external has been applied for all places of worship, a 10dB internal to external adjustment has been applied for schools.

4.3.6 Construction traffic noise

The main access routes for construction vehicles will be determined at a later stage and the potential noise impacts at sensitive receivers will be assessed in accordance with the RNP. However, given the existing traffic volumes through the site and the ability of workers to use the existing public transport network, the traffic noise impacts from construction activities are likely to be negligible.

Further investigation of likely traffic noise impacts would be completed by the contractor in the CNVMP, including the identification of appropriate management and mitigation measures, if required.

4.3.7 Construction vibration assessment

The vibration impacts generated by the works would be primarily during the basement excavation stage. The magnitude of the impacts would be largely controlled by the excavation approach and the equipment used. These details would be confirmed by the contractor and detailed in the contractors CNVMP. However, a high-level impact assessment can be completed to provide an indication of the likely impacts.

Provided below in Table 4-24 are recommended minimum safe working distances for vibration intensive plant. At the start of any vibration intensive works these distances should be confirmed through vibration site law measurements.

Table 4-24 Minimum safe working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance	
		Cosmetic damage	Human response
Vibratory roller	< 50kN (typically 1-2 tonnes)	5m	15m to 20m
	< 100kN (typically 2-4 tonnes)	6m	20m
	< 200kN (typically 4-6 tonnes)	12m	40m
	< 300kN (typically 7-13 tonnes)	15m	100m
	> 300kN (typically 13-18 tonnes)	20m	100m
	> 300kN (> 18 tonnes)	25m	100m
Small hydraulic hammer	300kg (5 to 12 tonnes excavator)	2m	7m
Medium hydraulic hammer	900kg (12 to 18 tonnes excavator)	7m	23m
Large hydraulic hammer	1600kg (18 to 34 tonnes excavator)	22m	73m
Vibratory pile driver	Sheet piles	2m to 20m	20m
Pile boring	≤ 800mm	2m (nominal)	4m
Jackhammer	Hand held	1m (nominal)	2m

The safe working distances identified in Table 4-24 indicate that vibration impacts for the most vibration intensive equipment has the potential to exceed the cosmetic damage limits as much as 22m from the source. Exceedance of the human response criteria could occur up to 100m away. These impacts are typical for a project of this

nature and highlight the importance of appropriate consideration in the contractors CNVMP.

The CNVMP should also identify other vibration sensitive structures such as tunnels, fibre-optic cable, gas pipelines and other underground infrastructure. Specific vibration goals should be determined for these items to mitigate potential structural damage.

4.4 Operational noise and vibration impacts

4.4.1 Site noise emissions

Building services noise emission

The environmental noise emission from the services plant in the proposed development should be assessed against the environmental criteria presented in section 4.2. This should be assessed in detail during design development.

Noise generated by the proposed development is expected to be controlled by a few major items of plant, including the following:

- heat pumps
- cooling towers
- stair pressurisation fans
- generators.

The cooling towers are currently planned to be located on the roof of the building towers. Noise mitigation including acoustic louvres and attenuators on the exhaust fans are currently considered in the design and should provide suitable noise attenuation to meet applicable noise criteria in section 4.2.3.

On the taller residential tower, mid-level heat pumps are proposed. Noise mitigation including ducted exhausts with an attenuator in the plenum have been considered to meet the applicable noise criteria. Heat pumps on the remaining towers would be located on the roof with suitable acoustic louvres and attenuators to meet the noise criteria. Smaller heat pumps are also located on the commercial podium to service the retail. Acoustic louvres and absorption within the plant room have been incorporated in the design to control noise breakout.

Stair pressurisation fans would generally be located on the roof, apart from the taller residential tower which would also include mid-level fans. Suitable attenuators have been included in the design to meet the applicable noise criteria.

Generators are required for the commercial towers. They would generally be located on the roof and require attenuators and acoustic louvres to attenuate noise associated with air flow paths.

Throughout the detailed design the cumulative impact of noise emissions from plant associated with the operation of the building would be assessed. Appropriate noise mitigation would be included in the design to meet the noise criteria in section 4.2.1. A review of potential plant and mitigation strategies has been completed and these mitigation strategies are considered reasonable and achievable.

Further information would be provided throughout the detailed design noise and vibration assessment to confirm appropriate noise attenuation ins included in the design to comply with the applicable noise criteria.

Emergency operations

Emergency operations for the SSD should be assessed against the criteria presented in Table 4-15 during the detailed SSD application. Acoustic treatments, such as attenuators, acoustic louvres and mufflers, should be incorporated into the design as required to meet the emergency operations noise emission criteria.

Sleep disturbance

Noise emissions from the proposal are controlled by the major mechanical plant discussed above. The plant generates continuous noise, with L_{Amax} maximum noise levels typically 1 to 2dB greater than the ambient L_{Aeq} noise levels. Compliance with the NPfI ambient noise criteria will also result in compliance with the sleep disturbance noise criteria.

It is expected that the following mitigation measures would be sufficient to minimise sleep disturbance:

- testing of emergency equipment, such as generators, during day-time periods
- implementation of mitigation measures for mechanical plant identified in section 4.6.

Event noise

With reference to Sydney Olympic Park Noise Management Guidelines, there are suggestions to minimise acoustic impacts of sporting and entertainment events on the land uses around these venues. Based on the worst case scenario of high noise events within the sporting/ entertainment venues in Sydney Olympic Park, the proposed development will require “substantial to some” noise mitigations for the external façade. A more detailed analysis for façade treatments will have to be undertaken in the Detailed SSDA stage of the assessment.

Moreover, DPE is reviewing the 2016 Night Time Economy Round Table Action Plan and the trial of Special Entertainment Precincts (SEP). While it is early days regarding when this strategy would proceed, it will likely have requirements to ensure that new development built in these SEPs are fit-for-purpose. Given the current stadium infrastructure in the area, it can reasonably be expected that Sydney Olympic Park will be designated an SEP. Any future development including the OSD/ASD would be subject to higher acoustic performance of the outer façade including external glazing.

As discussed above, it is likely that in the future Sydney Olympic Park would be established as a SEP. Event noise has the potential to increase the predicted noise impacts on the façade of the proposed development, which may increase the glazing requirements. These glazing requirements would be reviewed at the detailed design phase to confirm the building is fit-for-purpose with current DCP requirements.

Traffic noise intrusion

External noise intrusion will be controlled by the acoustic performance of the façade. The composite performance of the façade is expected to be controlled by the glazing. A preliminary traffic noise intrusion assessment has been undertaken using a representative traffic noise spectrum based on the CNOSSOS-EU light, medium-heavy and heavy traffic spectrums noise levels incident on the building façade were determined from the unattended noise measurements detailed in section 4.1.2. Noise levels at these measurement locations were used to adjust the traffic noise spectrum to assess the worst affected façade of the commercial buildings and residential buildings of the proposed development.

The following indicative glazing options for the façade construction for office and residential uses are recommended.

Residential

The recommended minimum façade glazing specification for typical residential properties provided are:

- single laminated glass at least 10.38mm thick, or
- Insulated glass unit (IGU) with 4mm/12mm air gap/4mm glazing.

Office

The recommended minimum façade glazing specification for typical commercial/ offices are:

- single laminated glass at least 9.38mm thick, or
- IGU with 4mm/12mm air gap/4mm glazing.

Regulating noise intrusion through the glazed windows is only effective with windows completely closed. Hence, an option for additional mechanical ventilation within the sleeping areas for residential properties is recommended.

Note that the specified glazing thickness only considers acoustic requirements and does not consider other requirements such as thermal, wind/structural loading, or safety.

The glazing recommendation is indicative only and would need to be reviewed during detailed design stage.

Sydney Metro ground-borne/structure-borne noise and vibration impacts

Vibration generated from the operation of the Sydney Metro West project can affect the proposed development through two transmission paths. The proposed development may be affected by structure-borne noise generated from the track and radiated up through the development above. The proposed development may also be affected by ground-borne noise generated by vibration radiating from the tunnel and through the soil into adjacent buildings.

These two transmission paths will be mitigated through track form design to ensure adequate vibration mitigation is achieved at the source to ensure criteria defined in section 4.2.3 is achieved. No further vibration isolation of the proposed development is required.

4.4.2 Road traffic generating development

The proposed basement under Buildings 2 and 3 will incorporate 358 car parking spaces which will cater for the proposed development. As per the existing surface parking spots, there are around 330 spots available which will be replaced by built structure in the proposed design.

It is expected that minor increase (28 parking spots) in car parking in the basement (external traffic noise from vehicle movement in the basement is much less than those compared with the surface vehicle movements) combined with the development of the Sydney Metro as an alternative transport mode to driving will lead to a reduction in road traffic noise associated with the site.

As such, no specific additional mitigation measures for road traffic noise are recommended as part of this approval. However, opportunities to minimise future potential impacts should be considered as the design develops.

4.4.3 Carpark noise emissions

The concept plan for Buildings 2 and 3 includes application for 358 underground car parking spaces. Any noise generated by these activities would be controlled by the underground structure. Further consideration of impacts is not required.

4.4.4 Loading dock noise emissions

The proposed loading dock for Buildings 2 and 3 is present on Basement Level 1 along with waste rooms and accessed via Precinct Street A.

Given that loading dock is on Basement Level 1, negligible noise impact is expected at the residential properties on upper floors of Buildings 2 and 3. However, opportunities to minimise future potential impacts should be considered as the design progresses which may include reviewing the glazing thickness for external windows for nearest sensitive apartments, reviewing operating times of the loading dock and type of vehicles being used.

4.4.5 Vibration impacts

It is anticipated that operational vibration impacts associated with the development can be managed with standard mitigation measures. A summary of the noise and vibration mitigation measures relevant to the operation of the proposal is presented in Table 4-26. The list of measures will be reviewed and refined as part of the detailed design such that the operational noise and vibration requirements are met.

4.5 Construction noise and vibration measures

Construction noise and vibration impacts should be mitigated in accordance with the Transport for NSW (TfNSW) Construction Noise Strategy and the Sydney Metro West - Construction Noise and Vibration Standard.

4.5.1 Construction noise and vibration management plan

Prior to the commencement of major construction works the contractor should develop a detailed CNVMP. The CNVMP should:

- identify relevant construction noise and vibration criteria as detailed in this report
- identify neighbouring land uses that are sensitive to noise and vibration
- summarise key noise and vibration generating construction activities and the associated predicted levels at neighbouring land uses
- identify reasonable and feasible work practices to be implemented during the works
- summarise stakeholder consultation and complaints handling procedures for noise and vibration.

4.5.2 Managing predicted exceedances from modelled construction scenarios

As exceedances of the construction noise management levels were predicted in section 4.3.4 for non-residential sensitive receivers and nearby commercial receivers. Further investigation should be undertaken in detailed design to manage these exceedances, including the following:

- The criteria for non-residential sensitive receivers are only applicable when the receiver is in use. Therefore, further investigation into the operation of these nearby sensitive uses should be undertaken to manage these impacts.

- The noise levels for these scenarios represent a typical worst-case with all equipment operating concurrently. These levels are considered conservative and as more detail about the construction methods and equipment is developed this can be refined further.

4.5.3 Standard mitigation measures

To manage the potential impact of noise and vibration during construction, feasible and reasonable management measures and work practices should be implemented.

The standard mitigation measures outlined in the TfNSW Construction Noise Strategy are reproduced in the Table 4-25. These mitigation measures are indicative only and will be firmed up in the detailed SSDA stage.

Table 4-25 Standard mitigation measures

Action required	Applies to	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise Ground-borne noise and vibration	In addition to the measures set out in this table, any project specific mitigation measures identified in the environmental impact assessment documentation (e.g. REF, submissions or representations report) or approval or licence conditions must be implemented.
Implement community consultation measures (refer to Appendix C of TfNSW Construction Noise Strategy for further details of each measure).	Airborne noise	• Periodic notification (monthly letterbox drop or equivalent)[1] • Website • Project infoline • Construction response line • Email distribution list • Community and stakeholder meetings • Community based forums (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise and vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all relevant project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.

Action required	Applies to	Details
Monitoring	Airborne noise Ground-borne noise and vibration	A noise monitoring program should be carried out for the duration of works in accordance with the CNVMP and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Attended vibration measurements shall be undertaken at all buildings within 20m of vibration generating activities when these activities commence to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Source controls		
Construction hours and scheduling	Airborne noise Ground-borne noise and vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period	Airborne noise Ground-borne noise and vibration	High noise and vibration generating activities[2] may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block[3]. No more than four consecutive nights of high noise and/or vibration generating work may be undertaken over any seven-day period, unless otherwise approved by the relevant authority.
Equipment selection	Airborne noise Ground-borne noise and vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits.
Maximum noise levels	Airborne noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Table 2 of the TfNSW Construction Noise Strategy.
Rental plant and equipment	Airborne noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the TfNSW Construction Noise Strategy.
Use and siting of plant	Airborne noise	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Plan worksites and activities to minimise noise and vibration	Airborne noise Ground-borne vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.

Action required	Applies to	Details
Non-tonal reversing alarms	Airborne noise.	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.
Minimise disturbance arising from delivery of goods to construction sites	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
Construction related traffic	Airborne noise	Schedule and route vehicle movements away from sensitive receivers and during less sensitive times. Limit the speed of vehicles and avoid the use of engine compression brakes. Maximise on-site storage capacity to reduce the need for truck movements during sensitive times.
Silencers on mobile plant	Airborne noise	Where possible reduce noise from mobile plant through additional fittings including: • residential grade mufflers • damped hammers such as “City” Model Rammer Hammers • air parking brake engagement is silenced.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436:1981 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.

Notes:
1. Detailing all upcoming construction activities at least 14 days prior to commencement of relevant works.
2. Includes jack and rock hammering, sheet and pile driving, rock breaking and vibratory rolling.
3. “Continuous” includes any period during which there is less than a 60-minutes respite between ceasing and recommencing any of the work.

4.6 Operational noise and vibration measures

A summary of the noise and vibration mitigation measures relevant to the operation of the proposal is presented in Table 4-26. The list of measures will be reviewed and refined as part of the detailed design such that the operational noise and vibration requirements are met.

Table 4-26 Operational recommendations summary

Operational item	Mitigation measures
Building services noise	Acoustic treatment has been recommended for the following mechanical plant: • cooling towers will incorporate acoustic louvres and attenuators on the exhaust fans • heat pumps will incorporate ducted exhausts with an attenuator in the exhaust plenum • stair pressurisation fans will include suitable attenuators • generators will incorporate attenuators and acoustic louvres. In general, standard acoustic treatments should be implemented for all major equipment installed as part of the proposed development to meet the established criteria. Standard acoustic treatments include the following: • acoustic barriers around roof top plant • robust construction of plant rooms • acoustic louvres to plant room openings • acoustic attenuators for mechanical ductwork • acoustic mufflers in generator exhaust systems • internal lining of ductwork • selection of low noise plant.
Building services vibration	All major equipment, installed as part of the proposed development, should be mounted on isolation mounts. The following measures should be adopted for mounting of mechanical plant: • Isolation mounts and connections should be provided for all reciprocating and rotating equipment, pipework and ductwork. • Selection of suitable vibration isolation systems should be made based on the design minimum isolation efficiency, floor static deflection, and plant/equipment mass, rotational/reciprocating speeds and power requirements etc. • The method of vibration isolation should be selected for each particular application. • A minimum clearance of 50mm between vibrating and rotating equipment and nearby building structure and 25mm between the underside of a concrete inertia block or machine base and the top of a concrete floor slab should be achieved. Contractors must ensure that any debris between items of plant and the building structure is removed. • Unless otherwise specified the manufacturers' recommendations for installation of vibration isolation mounts and flexible connections should be strictly observed. • Where metal (coil) springs are required, they should be provided with neoprene pads in series fixed to the base of the springs. • All rotary machinery should be accurately balanced both statically and dynamically.
Emergency operation	Acoustic treatments, such as attenuators, acoustic louvres and mufflers, should be incorporated into the design as required to meet the emergency operations noise emission criteria.
Sleep disturbance	Appropriate reasonable and feasible acoustic treatments should be incorporated into the design of the proposed development as required to minimise sleep disturbance. It is expected that the mitigation measures detailed above for building services noise will be sufficient for managing sleep disturbance.

Operational item	Mitigation measures
	Where possible, testing of emergency equipment, such as generators, should be scheduled during day-time periods.
Traffic noise intrusion	The preliminary assessment recommends an indicative glazing thickness of 10.38mm thick laminated glass for office and residential uses in the proposed development. The preliminary assessment indicates that mechanical ventilation is incorporated into sleeping areas so that residents can keep windows shut if desired. These recommendations will be reviewed during the detailed design stage and it is noted that non-acoustic requirements (e.g. structural, safety or mechanical plant emissions) may have additional façade requirements.
Sydney Metro ground-borne/structure-borne noise and vibration	It is expected that structure-borne noise and ground-borne noise relating to the operation of Sydney Metro will be mitigated through track form design. No further vibration isolation of the proposed development is anticipated.
Road traffic generated from development	Minor increase in total carparking spaces for the site in the basement and the availability of Sydney Metro as an alternative transport option to driving are expected to lead to a reduction in traffic noise related to the site. Therefore, no net increase in the ambient acoustic environment on surrounding roads is expected. No specific additional mitigation measures are recommended at this stage. Road traffic noise impacts should be reassessed during detailed design when existing and future traffic volumes are available to ensure compliance with the environmental noise criteria.
Car park noise emissions	No net increase to the ambient acoustic environment is expected due to a minor increase in car parking spaces and the fact that the carparking will be located underground. During detailed design where more information about traffic movements is available, car park noise emission should be assessed to ensure compliance with the environmental noise criteria. Further, opportunities to minimise potential impacts should be considered as the design develops.
Loading dock noise emissions	No net increase to the ambient acoustic environment is expected due to the loading dock being located underground. During detailed design where more information about loading dock movements is available, these noise emissions should be assessed to ensure compliance with the environmental noise criteria. Further, opportunities to minimise potential impacts should be considered as the design develops.

5 Conclusion

This Noise and Vibration Impact Assessment report presents the noise and vibration assessment results for the proposed development at Sydney Olympic Park. This report has been prepared to outline the noise and vibration impacts of the proposed development and to specifically respond to the SEARs issued for the Concept SSDA. Operational noise and vibration criteria for the proposed development have been established based upon the SEARs.

The key findings of the assessment of the end-state proposed Concept SSDA development are that:

- Noise sensitive receivers surrounding the site are similar distances away from any major roads or other noise emitting sources. The noise environment within NCA 1 and NCA 2 is considered urban and dominated by traffic noise from Olympic Boulevard and Australia Avenue respectively. Distant traffic noise from Homebush Bay Drive and Western Motorway also affects the background noise at both these NCAs.
- Operational and construction noise and vibration criteria has been established based on the stipulated standards and guidelines.
- The Proposed Sydney Olympic Park Master Plan 2030 (Interim Metro Review) provides guidance for proposed development within the Sydney Olympic Park. The primary focus of these guidelines is to minimise potential acoustic impacts of sporting and entertainment venues on other land uses within and around the park. Table 4-20 provides guidance on the amount of external façade treatment required for residential buildings due to noise from sporting/entertainment events.
- Indicative noise levels have been predicted for the nominated construction scenarios. The nearest residential receiver is more than 100m from the construction works, therefore the construction noise impacts are limited due large distance and intervening buildings. An exceedance of less than 5dB has been predicted at the nearest residential receiver which will be revised in the detailed SSDA stage based on a more realistic construction itinerary.
- The proposed development is intended to follow the construction of the Sydney Olympic Park metro station. However, the integrated nature of the delivery of the proposed development and Sydney Olympic Park metro station may lead to concurrent construction of some components of the station and proposed development. A detailed construction itinerary would be developed by the site contractors for the proposed development which would include duration and timing of the construction. The cumulative predicted levels presented in Table 4-23 are all stages operating simultaneously. It is unlikely that major construction noise would be generated on the podium and tower of the same building concurrently, this scenario has been included as a conservative approach.
- The main access routes for construction vehicles will be determined at a later stage and the potential noise impacts at sensitive receivers will be assessed in accordance with the RNP. However, given the existing traffic volumes through the site and the ability of workers to use the existing public transport network, the traffic noise impacts from construction activities are likely to be negligible.
- Vibration generated for the operation of the Sydney Metro West project can affect the proposed development through two transmission paths namely structure-borne noise and ground-borne noise. These two transmission paths will be mitigated through track form design to ensure adequate vibration mitigation is achieved at the source to ensure criteria defined in section 4.2.3 is achieved. No further vibration isolation of the proposed development is required.

- Proposed development multi-level basement will incorporate 358 car parking spaces which will cater for the proposed development. As per the existing surface parking spots, there are around 330 spots available which will be replaced by built structure in the proposed design. It is expected that minor increase in car parking in the basement (external traffic noise from vehicle movement in the basement is much less than those compared with the surface vehicle movements) combined with the development of the Sydney Metro as an alternative transport mode to driving will lead to a reduction in road traffic noise associated with the site.

The following mitigation measures and recommendations are proposed for the Concept SSDA development.

- Major noise and vibration emitting sources from the proposed development have been identified, such as traffic and plant, and should be treated to meet the established criteria with the use of standard acoustic treatments.
- With reference to Sydney Olympic Park Noise Management Guidelines, there are suggestions to minimise acoustic impacts of sporting and entertainment events on the land uses around these venues. Based on the worst case scenario of high noise events within the sporting/entertainment venues in Sydney Olympic Park, the proposed development will require “substantial to some” noise mitigations for the external façade.
- Moreover, DPE is reviewing the 2016 Night Time Economy Round Table Action Plan and the trial of SEP. While it is early days regarding where this strategy will proceed, it will likely have requirements to ensure that new developments built in these SEPs are fit-for-purpose. Given the current stadium infrastructure in the area, it can reasonably be expected that Olympic Park will be designated an SEP. Any future development including the OSD/ASD would be subject to higher acoustic performance of the outer façade including external glazing.
- Noise and vibration intrusion to the proposed development from the station and tunnel, from sources such as rail induced noise and vibration, public address systems, engine noise and emergency and ventilation equipment, is expected to be controlled at the source and within the station and tunnel envelopes.
- It is expected that the implementation of standard acoustic mitigation measures would be sufficient to meet all operational noise and vibration criteria established in this report in line with the SEARS.
- Indicative construction scenarios applicable to the proposed development have been modelled and construction noise levels at nearby sensitive receivers have been predicted to exceed the established noise management levels at some residential and commercial receivers due to their proximity to the site. A CNVMP should be developed as part of the Detailed SSDA to manage and minimise potential impacts on nearby receivers.
- Construction noise and vibration impacts should be mitigated in accordance with the TfNSW Construction Noise Strategy and the Sydney Metro West - Construction Noise and Vibration Standard. Typical mitigation measures are provided in section 4.5.3 which should be revised in the detailed design phase.

6 References

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Sydney Olympic Park Noise Management Guidelines, Report No. 99053, July 2002

Sydney Metro West Environmental Impact Statement Westmead to The Bays and Sydney CBD Technical Paper 2 Noise and Vibration

Appendix A Construction noise contour maps

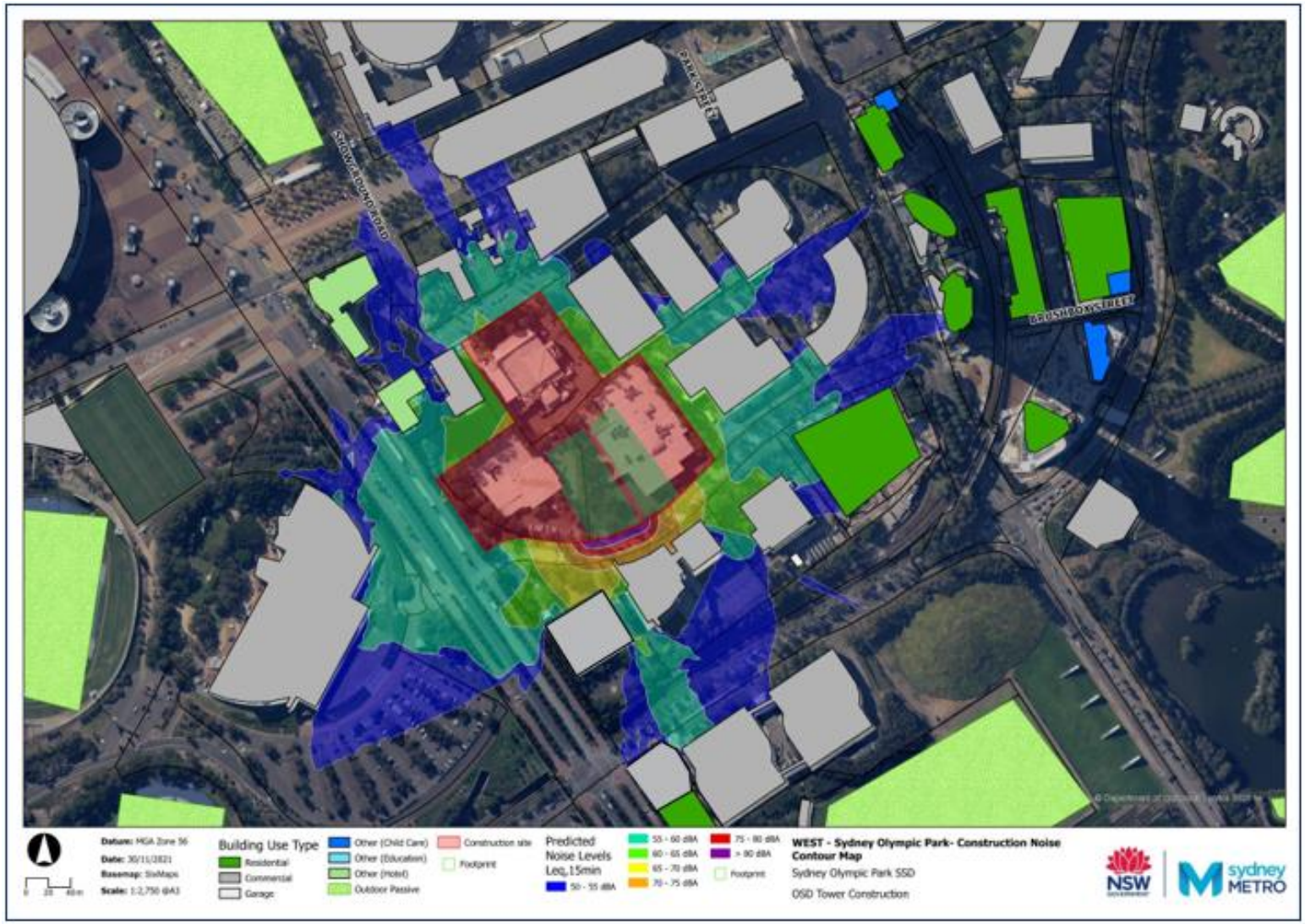

Figure A-1 OSD/ASD tower construction noise contours

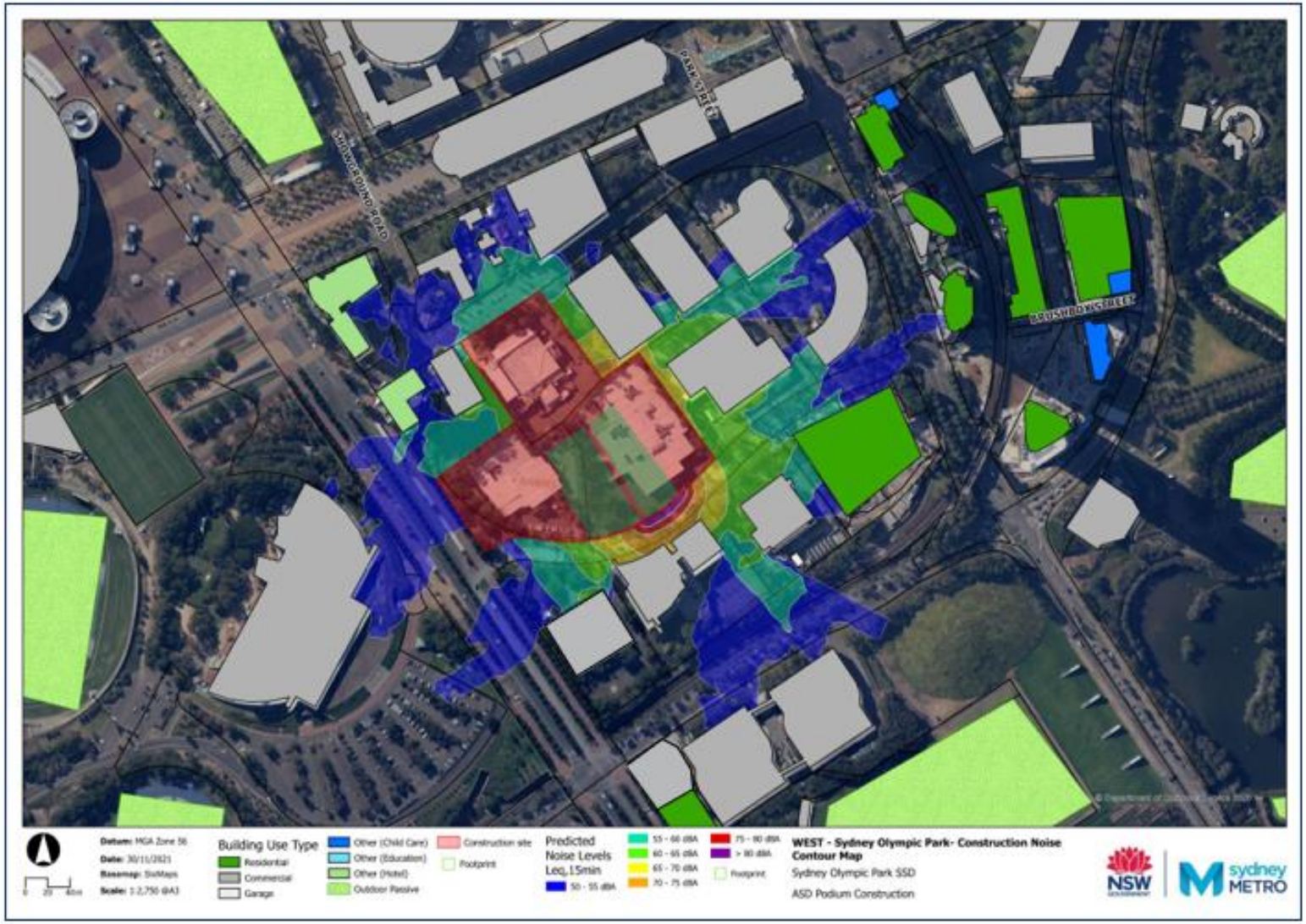

Figure A-2 Podium construction noise contours

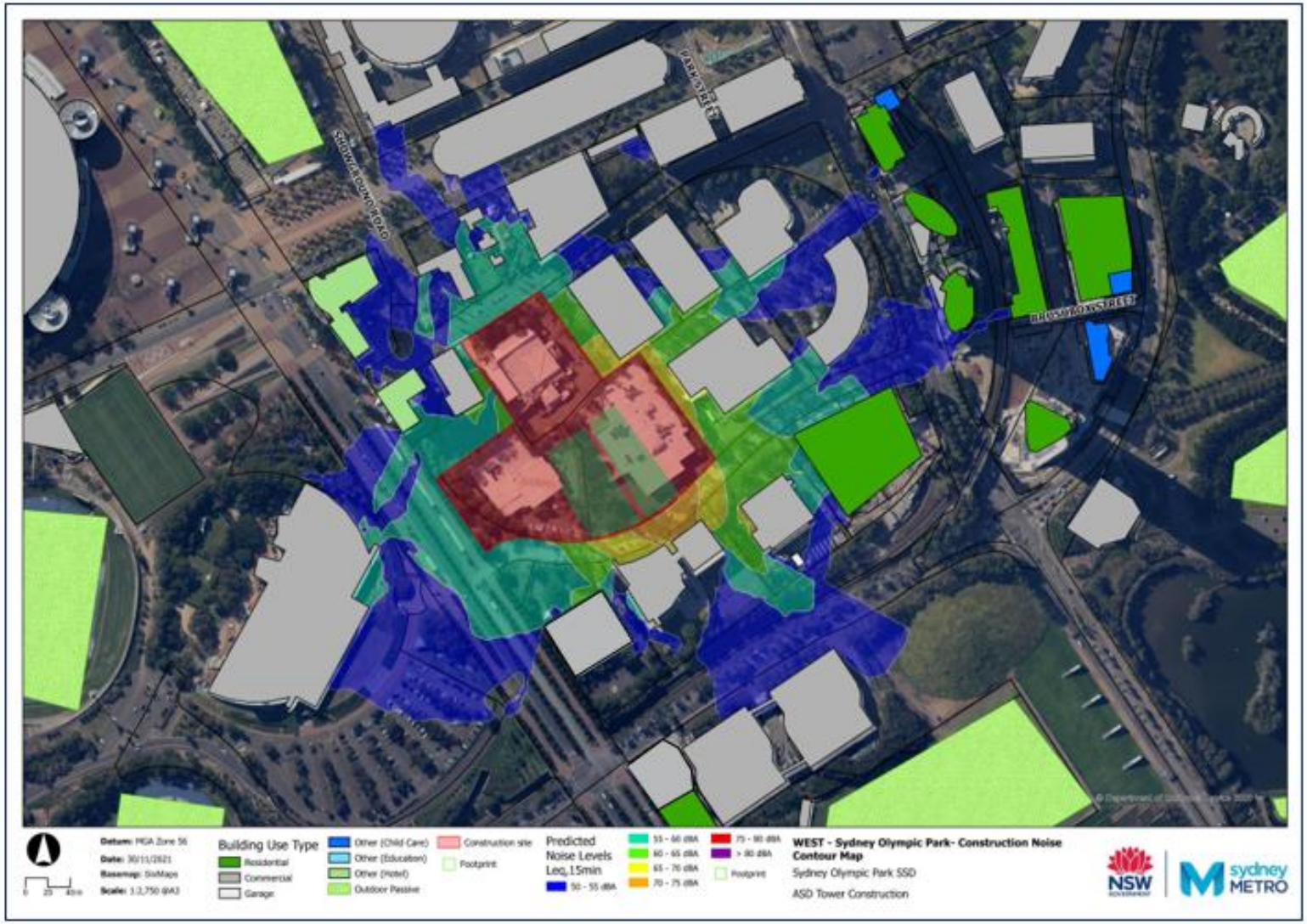

Figure A-3 Tower construction noise contours

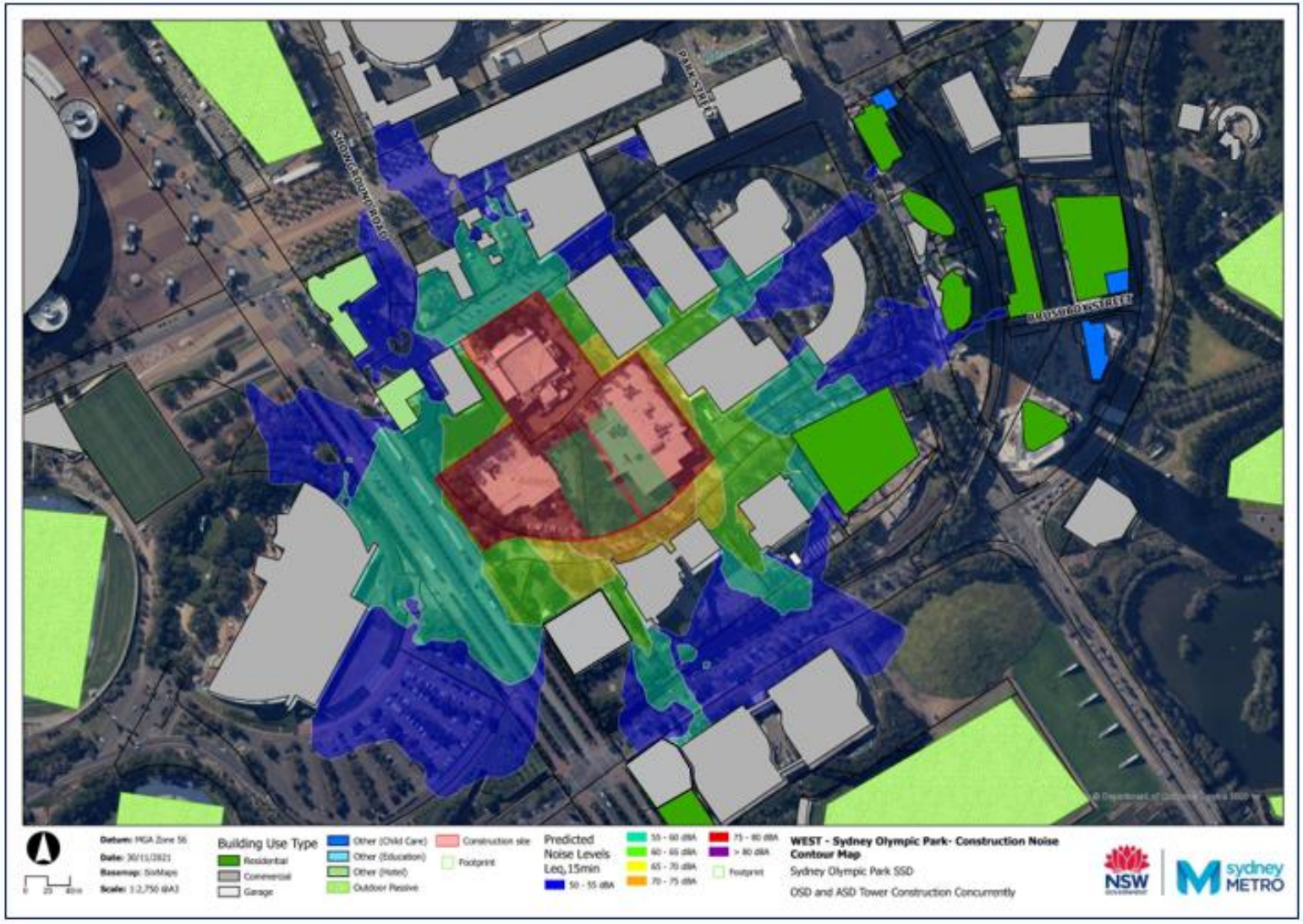

Figure A-4 Cumulative OSD/ASD Tower construction noise contours