



MARSHALL DAY 
Acoustics

LILYFIELD SKATE PLAZA CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Rp 002 r01 20210994 | 11 February 2022

Project: **LILYFIELD SKATE PLAZA**

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Report No.: **Rp 002 r01 20210285**

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EXECUTIVE SUMMARY

Marshall Day Acoustics (MDA) has been engaged by SJB Planning, on behalf of Inner West Council, to conduct an assessment of noise and vibration relating to the construction of the proposed Lilyfield Skate Plaza (the Project) to be located within Leichhardt Park in Lilyfield. This acoustic assessment is to supplement a Review of Environmental Factors (REF) to be submitted to Inner West Council.

Noise criteria applicable to the Project with respect to the proposed construction activities have been derived considering the NSW Department of Environment and Climate Change's *'Interim Construction Noise Guideline'* (ICNG).

The ICNG aims to provide a clear understanding of ways to identify and minimise noise from construction and demolition works through applying all 'feasible' and 'reasonable' work practices to control noise impacts. The guideline provides airborne noise criteria, identifies sensitive land uses and provides quantitative and qualitative assessment methods and subsequently advises on appropriate work practices.

In this report, noise and vibration from the proposed works are predicted based on the plant and equipment likely to be used during the three main stages of the construction works, as advised by SJB Planning. Calculated noise levels presented in this assessment include the effects of the noise control recommendations specific to each proposed construction stage detailed in this report.

The predictions indicate that noise levels during the proposed construction stages are expected to be up to 19 dB above the applicable noise affected management level, as derived following guidance in the ICNG, but generally remain below the highly noise affected management level indicated in the ICNG, during the longer-term "Average" noise emissions at the nearest identified residential receivers.

The "Worst-case" assessment scenario, representing the loudest noise levels likely to be exhibited during the proposed works, are predicted to be up to 25 dB above the noise affected management level and up to 4 dB above the highly noise affected management level. The "Worst-case" assessment scenario comprises the noisiest pieces of equipment (i.e. excavator with hammer) operating at the closest point of the worksite to the subject receiver. In practice, such concurrent works may not actually occur and if they did would only occur for brief periods (hours or days) during the wider works period.

Exceedances of noise affected management levels are typical of demolition and construction sites in close proximity to residential receivers. Further, since all works are restricted to take place only during the daytime, noise impacts will not be experienced during the most sensitive time period i.e. night-time. The ICNG recommends that for situations in which the noise affected noise management levels are exceeded, all feasible and reasonable work practices should be adopted.

As such, in addition to the feasible and reasonable physical noise controls detailed in this report, noise management techniques designed to limit the severity of noise impacts will need to be developed. A full CNVMP will be required later to be prepared by the builder once appointed and detailed, site specific construction methods are known. A detailed Construction Noise and Vibration Management Plan (CNVMP) is required to be prepared such that all feasible and reasonable noise management practices are adopted, including consultation with the community. Conceptual considerations for a CNVMP are proposed in this report.

Construction traffic on the sounding local roads has been investigated and has been determined to be unlikely to give rise to adverse impacts.

Indicative safe working distances from the vibration intensive plant items applicable for cosmetic damage and human comfort are provided in this report. Safe working distances have been developed to establish a trigger point at which further detailed evaluation e.g. vibration monitoring should be implemented. Receivers in the vicinity of the site are sufficiently distant from the proposed vibration intensive work areas for both cosmetic damage and human comfort considerations. Therefore, further vibration monitoring or mitigation is not indicated to be required.

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by SJB Planning, on behalf of Inner West Council, to conduct an assessment of noise and vibration relating to the construction of the proposed Lilyfield Skate Plaza (the Project) to be located within Leichhardt Park in Lilyfield. This acoustic assessment is to supplement a Review of Environmental Factors (REF) to be submitted to Inner West Council.

Technical terms used throughout this report are described in Appendix A. This assessment considers assessment guidance and noise criteria detailed in NSW Department of Environment and Climate Change's 'Interim Construction Noise Guideline' (ICNG).

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Location

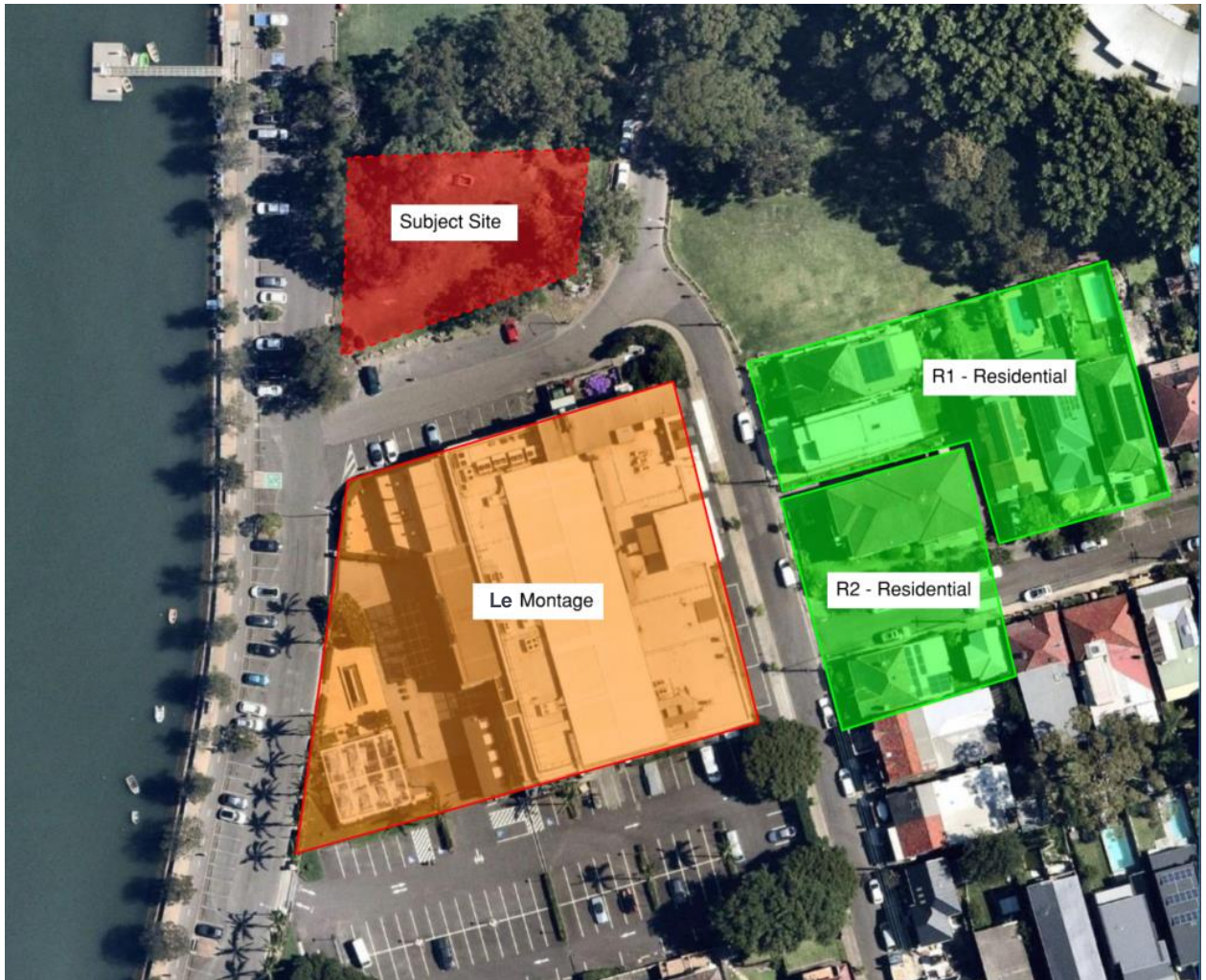
The Lilyfield Skate Plaza is proposed to be located on the south-western corner of Leichhardt Park, to the eastern side of Maliyawul Street and associated parking areas and to the north of an unnamed road which links Frazer Street and Maliyawul Street.

The nearest noise sensitive receivers surrounding the proposed site have been clustered into Noise Catchment Areas (NCAs) listed in Table 1. Receivers within a particular NCA, are expected to receive similar noise levels during the proposed construction works. An aerial photo showing the construction site and the established NCAs are provided in Figure 1.

Table 1: Noise sensitive receivers identified for assessment

| NCA ID | Location | Receiver Type | Description |
|------------|---------------------------------|---------------|--|
| R1 | South-east of the proposed site | Residential | Single and double storey residential buildings with a direct line of sight to the proposed development. This group of residential receivers represents the closest sensitive residential receivers located south-east of the subject site. |
| R2 | South-east of the proposed site | Residential | Single and double storey residential buildings without a direct line of sight to the proposed development. This group of residential receivers represents the closest sensitive residential receivers located south-east of the subject site with no direct line of sight to the site. |
| Le Montage | South of the proposed site | Commercial | Le Montage is located approximately 20 m south of the proposed site. |

Figure 1: Subject site, surrounds and NCAs



3.0 CONSTRUCTION HOURS

This assessment considers work occurring during standard daytime construction hours, as defined in the ICNG:

- Monday to Friday from 0700 hrs to 1800 hrs;
- Saturday 0800 hrs to 1300 hrs; and
- No works on Sundays or public holidays.

4.0 EXISTING NOISE LEVELS

In order to carry out a construction noise assessment, a survey of background noise levels is typically required to be conducted at a location close to the site boundary. As part of the wider noise assessment, including the assessment of Project operational noise included in the REF, it was not feasible to conduct representative background noise measurements due to the impacts of the COVID-19 pandemic.

In order to establish typical background noise levels associated with the Project site and surroundings, MDA has referred to the Transport for NSW *Construction and Maintenance Noise Estimator* (the estimator) which provides guidance on typical background noise levels, for example, locations based on the local environment and proximity to traffic arteries.

The estimator groups example areas into noise area categories (R0 to R5) previously defined under AS 1055.3-1997¹. While these categories are no longer defined within the most recent version of AS 1055:2018², the estimator provides useful guides of the expected typical Rating Background Noise Levels (RBL) for different areas.

Based on the guidance provided by the estimator, the Project area and surroundings have been classed as an R2 category, representing residential receivers subject to noise impacts from an arterial road (the nearby A4 City-West Link Rd).

Associated estimated day and evening RBLs are detailed in Table 2. Only the day period is considered in this assessment as construction works are only proposed to occur during the day period.

Table 2: Estimated RBLs for category R2

| Time period and description | RBL, dB LA90 |
|----------------------------------|--------------|
| Daytime Period (0800 – 1800 hrs) | 45 |
| Evening Period (1800 - 2200 hrs) | 40 |

5.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

5.1 Construction Noise and Vibration Criteria

MDA has reviewed Inner West Council's *Leichhardt Development Control Plan 2013* which currently applies to the suburb of Lilyfield. In the absence of a specific Council requirement regarding the assessment of construction noise and vibration, the assessment presented in this report is carried out in accordance with the following relevant Policies and Guidelines:

- *Interim Construction Noise Guideline*, NSW Department of Environment and Climate Change (ICNG);
- *Assessing Vibration: A Technical Guideline 2006*, NSW Department of Environment and Conservation (AVTG);
- *NSW Road Noise Policy*, NSW Department of Environment and Climate Change (RNP).
- *Australian/New Zealand Standard AS/NZS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors*

5.1.1 Airborne construction noise criteria

Airborne construction noise criteria applicable to the subject site are derived in accordance with the ICNG and are summarised in Appendix B. These criteria apply to airborne noise emissions related to construction activity during the recommended standard hours only.

Table 3: External airborne construction noise criteria

| NCA ID | Receiver Type | Management Level, LAeq (15 min) | |
|-------------------------|---------------|---------------------------------|-----------------------|
| | | Noise affected | Highly noise affected |
| R1 & R2 | Residential | 55 | 75 |
| Le Montage ¹ | Restaurant | | 60 |

¹ AS 1055.3-1997 *Acoustics - Description and measurement of environmental noise - Acquisition of data pertinent to land use*

² AS 1055:2018 *Acoustics - Description and measurement of environmental noise*

¹ The management level for this receiver is not distinguished as either noise affected or highly noise affected but is set as a single management level specific to a restaurant receiver as defined in AS2107:2000. See Appendix B.

The noise affected level is the noise level above which there may be some community reaction to noise. The highly noise affected level represents the noise level above which there may be a strong community reaction to noise. Where the noise affected management level is predicted to be exceeded, the ICNG requires that all feasible and reasonable work practices be employed. Where it is predicted that the highly noise affected management level will be exceeded, respite periods may need to be considered.

5.1.2 Construction traffic noise criteria

In accordance with the ICNG, potential noise impact from construction traffic on public roads to and from the subject site should be assessed under the NSW EPA's *Environmental Criteria for Road Traffic Noise*. This policy, however, has been superseded by the NSW EPA's *NSW Road Noise Policy* (RNP).

The current RNP provides noise level criteria for increased traffic flow as a result of land-use development with the potential to create additional traffic. Table 4 presents the traffic noise criteria applicable to this project.

Table 4: Road traffic noise criteria

| Type of Development | Criteria | |
|--|---|---|
| | Day 0700-2200 hrs | Night 2200-0700 hrs |
| Existing residences affected by additional traffic on existing local roads generated by land use development | L _(Aeq1hr) 55 dBA (external) | L _(Aeq1hr) 50 dBA (external) |
| Le Montage (when in use)* | L _(Aeq1hr) 60 dBA (external) | |

*In accordance with the RNP recommendations for commercial and industrial premises, the desirable internal noise levels are determined based on the 'Maximum' recommended design sound levels contained in *Australian Standard 2107:2000* for restaurants. The 'Maximum' recommended design sound level is selected due to the temporary nature of construction noise. A typical outside to inside level difference of 10 dB is applied.

Additionally, the RNP states that:

"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the Development should be limited to 2 dB above that of the noise level without the Development"

noting that:

"a increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person."

This limit applies wherever the noise level without the deployment is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.

5.1.3 Human comfort vibration targets

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents. Human comfort due to vibration from construction works is assessed under the NSW EPA document *Assessing Vibration – a technical guideline* (AVTG).

The AVTG provides guidance with respect to intermittent, impulsive and continuous vibration sources, which can be generated by construction activities. The vibration characteristics of many construction activities (e.g. excavation, rock breaking and pilling) are generally considered to be

intermittent. Continuous vibration sources may include tunnel boring and impulsive vibration sources may include drop piling or blasting.

Intermittent vibration

The vibration characteristics of most construction activities (e.g. excavation and pilling) are considered to be intermittent. Intermittent vibration can be defined as interrupted periods of continuous vibration (e.g. heavy truck pass bys or rock breaking) or continuous periods of impulsive vibration (e.g. impact pile driving). Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period. Hence, for intermittent vibration, human disturbance vibration levels are assessed on the basis of the Vibration Dose Value (VDV), based on the level and the duration of the vibration events. Vibration criteria applicable to the site for intermittent vibration sources, are summarised in Table 5. Only Day time criterion is provided as no out of hours construction activities are expected.

Table 5: Preferred and maximum vibration levels for human disturbance limits

| Location | Daytime (0600-2200 hrs) ¹ | |
|------------|--------------------------------------|--------------------|
| | Preferred Value, VDV | Maximum Value, VDV |
| Residences | 0.2 | 0.4 |

Note: 1 - Daytime is 7.00 am to 10.00 pm and Night-time –s 10.00 pm to 7.00 am.

2 - These criteria are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

Continuous and impulsive vibration

Vibration criteria applicable to the site for continuous vibration sources, are summarised in Table 6. Only Daytime criteria are provided as no out of hours construction activities are expected.

Table 6: Preferred and maximum vibration levels for–human disturbance limits - Continues and Impulsive vibration

| Vibration type | Location | Assessment period | Preferred values (m / s ²) | | Maximum values (m / s ²) | |
|----------------------|------------|-------------------|--|--------------|--------------------------------------|--------------|
| | | | z axis | x and y axes | z axis | x and y axes |
| Continuous vibration | Residences | Daytime | 0.010 | 0.0071 | 0.020 | 0.014 |

Note: 1- the preferred and maximum values are weighted RMS acceleration values in accordance with NSW EPA document *Assessing Vibration – a technical guideline*.

2- These criteria are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

5.1.4 Cosmetic structural vibration targets for non-sensitive structures

The EPA does not provide direct guidance for the assessment of vibration-induced damage to structures or buildings. The recommended vibration targets (guide values) to minimise the risk of cosmetic damage to non-sensitive structures (i.e. residential and industrial buildings) are to be assessed using BS 7385 Part 2-1993 '*Evaluation and measurement for vibration in buildings Part 2*'.

Table 7: Transient vibration guide values for cosmetic damage for non-sensitive structures, (PPV) mm/s

| Type of Building | Peak Component Particle Velocity in Frequency Range of Predominant Pulse | |
|---|--|-----------------|
| | 4 Hz to 15 Hz | 15 Hz and Above |
| Reinforced or framed structures Industrial and heavy commercial buildings | 50 mm / s at 4 Hz and above | |

| Type of Building | Peak Component Particle Velocity in Frequency Range of Predominant Pulse | |
|--|--|---|
| | 4 Hz to 15 Hz | 15 Hz and Above |
| Unreinforced or light framed structures 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 |

BS 7385 Part 2-1993 recognises adjustments to the guide values in Table 7 depending on the type of activity and the vibration receiver. For construction activities involving intermittent vibration sources (i.e. rock breakers, piling rigs, vibratory rollers, excavators), conservative vibration damage screening levels per receiver type are provided:

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

5.2 Construction Airborne Noise Prediction

5.2.1 Assessment scenarios

The following major stages are proposed during the construction works. These stages of works are provided by the client via email, dated 19 January 2022.

- Stage 1 – Demolition/Civil works;
- Stage 2 – Excavation and disposal;
- Stage 3 – Construction – Structure.

For each of the above stages, two scenarios were developed to represent the works potentially having the greatest noise impact on the surrounding receivers. Noise levels for these works have been calculated for the following scenarios:

“Average” (Av.): it is assumed that most proposed plant items nominated by the client will be working concurrently towards the centre of the construction site between 10 % to 100 % of the time over a 15-minute period.

“Worst-case” (WC): it is assumed that the noisiest proposed plant items nominated by the client, where possible, will be working between 10 % to 100 % of the time over a 15-minute period near the boundary of the subject site.

Situations where noise sources would be located towards the centre of the site i.e. the “Average” is likely to be representative of the longer-term average noise emissions.

5.2.2 Conceptual construction plant items and sound power

A conceptual schedule of works and associated equipment have been provided by the client via email, dated 19 January 2022. A summary of the equipment items and assumed operating duty (percentage of time operating per 15-minute period) for each stage of construction work, is provided in Table 8.

Table 8: Assumed duration (% of 15-minute) of equipment to be operating simultaneously in a 15-minute period at the subject site

| construction Equipment | Demolition/Civil Works | | Excavation and Disposal | | Construction - Structure | |
|---|------------------------|---------|-------------------------|---------|--------------------------|---------|
| | Worst-case | Average | Worst-case | Average | Worst-case | Average |
| 1 x Tracked 13.5 t excavator | — | 25% | — | 50% | — | — |
| 1 x Excavator with hammer | 50% | 25% | — | — | — | — |
| 1 x Bogie truck | — | — | 50% | 10% | — | 10% |
| 1 x Water cart | — | — | — | 10% | — | — |
| 1 x Concrete pump truck | — | — | — | — | 50% | 25% |
| 1 x Concrete vibrator | — | — | — | — | — | 25% |
| 1 x Mechanical concrete floats over flat concrete | — | — | — | — | — | 25% |
| 1 x Diamond core drill | — | — | — | — | 25% | 10% |
| 1 x Hand tools (electric) drill | — | — | — | — | — | 10% |
| 1 x Concrete agitator truck | — | — | — | — | 50% | 25% |
| 1 x Delivery truck | — | — | — | — | — | 10% |
| 1 x Generator | — | — | — | — | — | 75% |
| 1 x Air compressor & line | — | — | — | — | — | 25% |
| 1 x De-watering plant & pump | — | — | — | — | — | 25% |
| 1 x Pressure cleaner | — | — | — | — | — | 10% |

Note: Assessment scenarios “Average” and “Worst-case” are described in Section 5.2.1

Associated sound power noise data for these plant items are provided in Appendix C.

5.2.3 Modelling assumptions

Noise levels have been calculated at 1.5 m above ground level in accordance with the requirements of the ICNG and at various distances from the boundary of the receivers. Calculated noise levels include the effects of the noise control recommendations specific to each construction stage detailed in Section 5.2.4.

5.2.4 Physical noise control recommendations

Based on the conceptual construction methods and plant items, MDA recommend that the noise control measures detailed in Table 9 are implemented on-site. Predicted construction noise levels in this assessment, include the effect of these recommendations.

Table 9: Noise control recommendations for site

| Stage | Equipment/Location | Recommendation |
|--------------------------|--------------------------------------|---|
| Demolition/Civil Works | Excavator with hammer | <ul style="list-style-type: none"> - Localised noise barriers should be utilised when this equipment is in use. - Temporary noise barriers (e.g. ECHO Barrier or Flexshield) should be mobile and extend to a height 1 m above noise source. - Barrier should envelop the work location to ensure no direct line of sight to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4 m of the noise source. |
| Excavation and Disposal | N/A | N/A |
| Construction - Structure | Diamond core drill Air compressor | <ul style="list-style-type: none"> - Localised noise barriers should be utilised when this equipment is in use. - Temporary noise barriers (e.g. ECHO Barrier or Flexshield) should be mobile and extend to a height 1 m above noise source. - Barrier should envelop the work location to ensure no direct line of sight to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4 m of the noise source. |

The above noise control recommendations are provided to control noise from the noisiest plant and equipment items. A full, detailed CNVMP will be required later to be prepared by the builder once appointed and a detailed construction methods are available.

5.2.5 Summary of construction noise assessment

Predicted noise levels from construction activities have been calculated based on the conceptual construction information provided by SJB Planning. Detailed noise prediction results and discussion of numerical compliance are provided in Appendix D.

The predictions indicate that noise levels during the proposed construction stages are expected to be up to 19 dB above the noise affected management level but generally remain below the highly noise affected management level during the longer-term average noise emissions, referred to as the “Average” assessment scenario, at the nearest identified residential receivers.

The “Worst-Case” assessment scenario, representing the loudest noise levels likely to be exhibited during the proposed works, are predicted to be up to 25 dB above the noise affected management

level and up to 4 dB above the highly noise affected management level. The “Worst-case” assessment scenario comprises the noisiest pieces of equipment (i.e. excavator with hammer) operating at the closest point of the work site to the subject receiver. In practice, such concurrent works may not actually occur and if they did would only occur for brief periods (hours or days) during the wider works period. In the unlikely event that “Worst-case” noise levels occur for longer periods of time, respite periods will need to be implemented. Respite periods, if required, must be defined in greater detail as part of a detailed assessment of construction noise to be prepared once a main contractor is appointed.

Exceedances of noise affected management levels are typical of demolition and construction sites in close proximity to residential receivers. Further, since all works are restricted to take place only during the daytime, noise impacts will not be experienced during the most sensitive time period i.e. night-time. The ICNG recommends that for situations in which the noise affected management levels are exceeded, all feasible and reasonable work practices should be adopted.

Based on the above, proposed construction works have the potential to give rise to adverse noise impacts at residential receivers. As such, in addition to the feasible and reasonable physical noise controls detailed in this report, noise management techniques designed to limit the severity of noise impacts are required to be adopted. Therefore, a detailed Construction Noise and Vibration Management Plan (CNVMP) is required to be prepared such that all feasible and reasonable noise management practices are adopted, including consultation with the community. Conceptual inclusions for the CNVMP are proposed in Appendix E.

5.3 Construction Traffic Noise Assessment

The RNP notes that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Based on the information provided by the client via email dated 19 January 2022, up to one vehicle (light or heavy) per hour during the construction period is expected. We note that movements of one trucks per hour is unlikely to increase the existing traffic noise by more than 2 dB. On this basis, construction traffic noise is unlikely to be significant and not assessed further in this report.

5.4 Construction Vibration Assessment and Recommendations

The following vibration intensive plant are proposed to be used during construction:

- Excavator;
- Excavator with hammer.

5.4.1 Human comfort

The AVTG provides guidance with respect to the assessment of human comfort due to vibration from construction works. This guideline provides distinguishes intermittent, impulsive and continuous vibration sources, which can be generated by construction activities.

Intermittent vibration

The AVTG indicates that intermittent vibration should be assessed in terms of the Vibration Dose Value (VDV). These values for intermittent construction activities are highly specific to site conditions, equipment selections and operational durations. As such, calculation of VDV levels is not typical or practical at the planning stage but will need to be considered as part of a later detailed vibration assessment.

The AVTG recommends that best management practices in all cases should be to reduce values as far as practicable, and a comprehensive community consultation program should be developed.

Continuous vibration

Vibration due to some construction operations can be considered continuous depending on the duration and nature of the works. Since the guide values for continuous vibration are independent of exposure duration, indicative safe working distances can be developed and are provided in Table 10.

Table 10: Safe working distances for human comfort (continuous vibration sources), m

| Plant Items | Safe Working Distance ¹ , (m) |
|--|--|
| 12-18 t excavator with hydraulic hammer ^{1,2} | 23 |

Notes: 1. The values in this table apply to residential receivers.

2. Based on information published by TfNSW Construction Noise and Vibration Strategy.

Safe working distances have been developed to establish a trigger point at which further detailed evaluation e.g. vibration monitoring should be implemented. It should be noted that being located within the safe working distance does not necessarily mean that vibration criteria at a subject receiver is exceeded.

5.4.2 Cosmetic structural damage

Indicative criterion boundaries from the proposed vibration intensive plant items applicable for cosmetic structural damage are provided in Table 11.

Table 11: Criterion boundary – effects of vibration on structures, m

| Plant Items | Criterion boundary, (m) |
|--|-------------------------|
| 12-18 t excavator with hydraulic hammer ¹ | 7 |
| Excavator ² | 2 |

Notes: 1. Based on information published by TfNSW Construction Noise and Vibration Strategy and published by RTA Environmental Noise Management Manual

2. Based on measured data by MDA

The criterion boundary represents the distance from a vibration source within which the cosmetic structural criteria is likely to be exceeded.

5.4.3 Construction vibration recommendations

Where vibration intensive activities are proposed to be conducted close to sensitive receivers, and the criterion boundary or safe working distance may be broken, site measurements and alternative equipment or methodologies should be considered.

Where vibration intensive activities are proposed to be used within 2 m of any structurally sound building, site measurements and alternative equipment or methodologies should be employed.

The nearest residential receivers are located approximately 30 m to the south-east of the Project site (R1). These receivers are sufficiently distant from the proposed vibration intensive work areas for both cosmetic damage and human comfort considerations. Therefore, further vibration monitoring or mitigation is not indicated to be required.

APPENDIX A GLOSSARY OF TERMINOLOGY

| | |
|-----------------------------------|---|
| SPL or L_p | <p><u>Sound Pressure Level</u></p> <p>A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.</p> |
| SWL or L_w | <p><u>Sound Power Level</u></p> <p>A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.</p> |
| dB | <p><u>Decibel</u></p> <p>The unit of sound level.</p> <p>Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of $P_r=20 \mu\text{Pa}$ i.e. $\text{dB} = 20 \times \log(P/P_r)$</p> |
| dBA | <p>The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.</p> |
| A-weighting | <p>The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.</p> |
| $L_{Aeq}(t)$ | <p>The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.</p> <p>The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.</p> |
| $L_{A90}(t)$ | <p>The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.</p> <p>The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.</p> |
| L_{Amax} | <p>The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.</p> |
| SEL or L_{AE} | <p><u>Sound Exposure Level</u></p> <p>The sound level of one second duration which has the same amount of energy as the actual noise event measured.</p> <p>Usually used to measure the sound energy of a particular event, such as a train pass-by or an aircraft flyover</p> |
| R_w | <p><u>Weighted Sound Reduction Index</u></p> <p>A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.</p> |
| Vibration | <p>When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity.</p> |

Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

VDV

Vibration Dose Value

Vibration Dose Value is based on British Standard BS 6472:1992 Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz) and provides guidelines for the evaluation of whole body exposure to intermittent vibration.

VDV can be used to take into account the weighted measured RMS vibration from many vibration sources including rail vehicles, construction equipment such as jackhammers and industry. VDV takes into account the duration of each event and the number of events per day, either at present or in the foreseeable future and calculates a single value index.

APPENDIX B PROJECT SPECIFIC CRITERIA

The ICNG aims to provide a clear understanding of ways to identify and minimise noise from construction and construction works through applying all 'feasible' and 'reasonable' work practices to control noise impacts. The guideline identifies sensitive land uses and recommends construction hours, provides quantitative and qualitative assessment methods and subsequently advises on appropriate work practices.

For the project site, sensitive receivers and land uses have been identified. It is understood that construction activities on-site will not extend outside of the recommended standard hours detailed in Table B1.

Table B1: ICNG recommended standard hours of work

| Work Type | Recommended standard hours of work |
|---------------------|--|
| Normal Construction | Monday to Friday 0700 to 1800 hrs Saturdays 0800 to 1300 hrs No work on Sundays or public holidays |

Based on the recommended standard hours, the guideline provides airborne management levels for residential receivers and how they are applied as detailed in Table B 2.

Table B 2: Management levels for residential receivers, dB $L_{Aeq}(15min)$

| Management level, $L_{Aeq}(15 min)$ | How to apply |
|-------------------------------------|--|
| Noise affected: 55 (RBL + 10dB) | <p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <p>Where the predicted or measured $L_{Aeq,15 minute}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>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.</p> |
| Highly noise affected: 75dB(A) | <p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>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:</p> <ul style="list-style-type: none"> - 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. |

In addition to residential type receivers, ICNG provide noise management levels for industrial and commercial premises. However, for other business (e.g. restaurants like Le Montage), the guideline recommends the 'maximum' internal noise levels recommended in *Australian/New Zealand Standard AS/NZS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors* (AS2107:2000), in determining relevant noise levels. On this basis, an external management level of $L_{(Aeq1hr)}$ 60 dBA is determined for Le Montage receiver.

Based on the recommended standard hours of work, airborne noise criteria for receivers identified in this report are detailed in Table B 3.

Table B 3: Management levels for residential receivers, dB $L_{Aeq}(15min)$

| NCA ID | Receiver Type | Management level, L_{Aeq} (15 min) | |
|-------------------------|---------------|--------------------------------------|-----------------------|
| | | Noise affected | Highly noise affected |
| R1 & R2 | Residential | 55 | 75 |
| Le Montage ¹ | Restaurant | | 60 |

¹ The management level for these receivers are not distinguished as either noise affected or highly noise affected but is set as a single management level specific to a restaurant receiver as defined in AS2107:2000.

In accordance with ICNG, noise management levels apply when properties are being used and noise levels are to be assessed at the most affected occupied point of the premises.

Where noise from construction works is above the noise affected level, all feasible and reasonable work practises should be applied. Where the noise from construction works is above highly noise affected management level, restrictions to the hours of construction may be required.

APPENDIX C CONSTRUCTION NOISE SOURCES

A variety of excavation and construction equipment will be used for this project. At this early stage, a comprehensive plan of staging and equipment selection is not known. Table E1 provides a schedule of construction equipment that is anticipated to be used on this site and their noise levels as taken from:

- AS2436-2010: *Guide to noise and vibration control on construction, demolition and maintenance sit*
- BS5228-1-2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

Table E1: Demolition noise source sound power levels, dB L_{Aeq}

| Noise source | A-weighted sound power level, L _{Aeq} dB SWL | Source |
|--------------------------------------|---|---------------|
| 1 x Tracked 13.5t excavator | 106 | BS5228-1-2009 |
| 1 x Excavator with hammer | 128* | BS5228-1-2009 |
| 1 x Bogie truck | 107 | AS2436-2010 |
| 1 x Water cart | 107 | AS2436-2010 |
| 1 x Concrete pump truck | 108 | AS2436-2010 |
| 1 x Concrete vibrator | 103 | AS2436-2010 |
| 1 x Mechanical concrete floats | 100 | BS5228-1-2009 |
| 1 x Diamond core drill | 113 | BS5228-1-2009 |
| 1 x Hand tools (electric) drill | 102 | AS2436-2010 |
| 1 x Concrete agitator truck | 109 | AS2436-2010 |
| 1 x Delivery truck | 107 | AS2436-2010 |
| 1 x Generator | 99 | AS2436-2010 |
| 1 x Air compressor (silenced) & line | 101 | AS2436-2010 |
| 1 x De-watering plant & pump | 99 | BS5228-1-2009 |
| 1 x Pressure cleaner | 99 | BS5228-1-2009 |

* Includes a +5 dB factor in accordance with recommendations given in Section 4.5 of the ICNG.

APPENDIX D CONSTRUCTION NOISE IMPACT ASSESSMENT

Noise levels during the following stages have been calculated at the nominated receivers:

- Stage 1 – Demolition/Civil works;
- Stage 2 – Excavation and disposal;
- Stage 3 – Construction - Structure

Noise levels have been predicted under guidance from *AS2436-2010 Guide to noise control on construction, maintenance and demolition sites* and utilising the information provided in *BS 5228-1-2009 Code of practice for noise and vibration control on construction and open sites*.

Levels have been calculated for “Worst-Case” situations where noise sources will either be closest to the noise-sensitive receiver. Noise levels have also been calculated for the “Average” situation, with noise sources located towards the centre of the site. The latter is likely to be representative of the longer-term noise emissions.

D1 Stage 1 - Demolition/Civil works

Table D1 details the predicted noise levels at the NCAs nominated in Section 2.1 during Stage 1. Noise levels have been calculated at a position within the NCA that is most exposed to noise from associated activities.

The calculated levels indicate that noise levels from the proposed activities during this stage are expected to be generally below the highly noise affected management levels for the “Average” assessment scenario; and exceed the highly noise affected management levels for the “Worst-case” assessment scenario by up to 4 dB at some of the identified nearby receivers.

Predicted noise levels for residential receivers are expected to be up to 19 dB above the noise affected management levels for the “Average” assessment scenario, and up to 25 dB above the noise affected management levels for the “Worst-case” assessment scenario.

During this stage, the use of the Excavator with hammer, have the highest potential to impact on the noise receivers.

D2 Stage 2 - Excavation and disposal

Table D2 details the predicted noise levels at the NCAs nominated in Section 2.1 during Stage 2. Noise levels have been calculated at a position within the NCA that is most exposed to noise from associated activities.

The calculated levels indicate that noise levels from the proposed activities during this stage are expected to be below the highly noise affected management levels for both the “Average” and “Worst-case” assessment scenarios for all the identified nearby receivers.

Predicted noise levels for residential receivers are expected to be up to 7 dB above the noise affected management levels for the “Average” assessment scenario, and up to 9 dB above the noise affected management levels for the “Worst-case” assessment scenario.

During this stage, the use of the excavator and truck, has the highest potential to impact on the noise receivers.

D3 Stage 3 - Structure

Table D3 details the predicted noise levels at the NCAs nominated in Section 2.1 during Stage 3. Noise levels have been calculated at a position within the NCA that is most exposed to noise from associated activities.

The calculated levels indicate that noise levels from the proposed activities during this stage are expected to be below the highly noise affected management levels for both the “Average” and “Worst-case” assessment scenarios for all the identified nearby receivers.

Predicted noise levels for residential receivers are expected to be up to 10 dB above the noise affected management levels for the “Average” assessment scenario, and up to 15 dB above the noise affected management levels for the “Worst-case” assessment scenario.

During this stage, the use of the concrete pump truck and handheld tool, has the highest potential to impact on the noise receivers.

Table D1: Predicted noise levels during Stage 1 - Demolition/Civil works

| Receiver | Period | Assessment | Calculated noise level ^{2,3} , dB L _{Aeq} , 15min | Noise affected | | Highly noise affected | |
|------------|-------------------------------------|------------|---|---|----------------|--|----------------|
| | | | | Management level, dB L _{Aeq} , 15min | Exceedance, dB | Management level, dB L _{Aeq} , 15mins | Exceedance, dB |
| R 1 | Within guideline hours ² | Worst-case | 79 | 55 | 24 | 75 | 4 |
| | | Average | 74 | | 19 | | -- |
| R2 | Within guideline hours ² | Worst-case | 71 | 55 | 16 | 75 | -- |
| | | Average | 67 | | 12 | | -- |
| Le Montage | Within guideline hours ² | Worst-case | 85 | 60 | 25 | N/A | N/A |
| | | Average | 77 | | 17 | | N/A |

¹ Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

² Calculations included the recommended noise controls detailed in Section 6.3

³ Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG.

Table D2: Predicted noise levels during Stage 2 - Excavation and disposal

| Receiver | Period | Assessment | Calculated noise level ^{2,3} , dB L _{Aeq} , 15min | Noise affected | | Highly noise affected | |
|------------|------------------------------|------------|--|--|----------------|---|----------------|
| | | | | Management level, dB L _{Aeq} , 15min | Exceedance, dB | Management level, dB L _{Aeq} , 15mins | Exceedance, dB |
| R 1 | Within | Worst-case | 63 | 55 | 8 | 75 | -- |
| | guideline hours ¹ | Average | 62 | | 7 | | -- |
| R2 | Within | Worst-case | 49 | 55 | -- | 75 | -- |
| | guideline hours ¹ | Average | 49 | | -- | | -- |
| Le Montage | Within | Worst-case | 69 | 60 | 9 | N/A | N/A |
| | guideline hours ¹ | Average | 65 | | 5 | | N/A |

¹ Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

² Calculations included the recommended noise controls detailed in Section 6.3

³ Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG.

Table D3: Predicted noise levels during Stage 3 - Construction - Structure

| Receiver | Period | Assessment | Calculated noise level ^{2,3} , dB LAeq, 15min | Noise affected | | Highly noise affected | |
|------------|------------------------------|------------|---|-------------------------------------|----------------|--------------------------------------|-------------------|
| | | | | Management level, dB LAeq, 15min | Exceedance, dB | Management level, dB LAeq, 15mins | Exceedance, dB |
| R 1 | Within | Worst-case | 69 | 55 | 14 | 75 | -- |
| | guideline hours ² | Average | 65 | | 10 | | -- |
| R2 | Within | Worst-case | 56 | 55 | 1 | 75 | -- |
| | guideline hours ² | Average | 53 | | -- | | -- |
| Le Montage | Within | Worst-case | 75 | 60 | 15 | N/A | N/A |
| | guideline hours ² | Average | 68 | | 8 | | N/A |

¹ Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

² Calculations included the recommended noise controls detailed in Section 6.3

³ Unless noted otherwise, noise level calculated at 1.5m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG.

APPENDIX E CONCEPTUAL INCLUSIONS FOR CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

Prior to the commencement of construction, once a contractor is appointed and proposed construction methods and plant and equipment are finalised, a detailed Construction Noise and Vibration Management Plan (CNVMP) will need to be prepared. The CNVMP is a documented plan that should assist the construction team in managing and mitigating noise impacts as well communicating effectively with impacted stakeholders. Whilst the details of the CNVMP are outside of the scope of this document the following is provided for the consideration of those preparing the plan.

E1 Training

All staff will participate in an induction training session before starting work on the construction, with attention given to the following matters:

- Activities with the potential to generate high levels of noise and/or vibration;
- Mitigation and management measures;
- Sensitive receivers and any agreements made through engagement (if any); and
- Monitoring requirements (if any).

As the construction progresses, any updates of noise and vibration matters will be addressed during regular site meetings and/or 'toolbox' training sessions.

E2 Equipment Selection

When selecting construction equipment:

- Use quieter construction methodologies where practicable;
- Use electric motors rather than diesel engines where practicable;
- Use rubber-tracked equipment rather than steel tracked equipment where practicable;
- Use equipment that is suitably sized for the task;
- Maintain equipment well to minimise rattles, squeaks etc;
- Fit engines with exhaust silencers and engine covers where practicable;
- Avoid tonal reversing or warning alarms (beepers). Alternatives include broadband alarms (squawkers/quackers), flashing lights, proximity sensors, reversing cameras and spotters.

E3 Scheduling of Activities and Providing Respite Periods

Works during the proposed "Worst-case" works are predicted to be above the highly noise affected management levels at some of the identified nearby receivers. This is likely to occur during the use of excavator with hammer at the closest point of the work site to the subject receiver which is identified as "Worst-case" assessment scenario in this document. Based on the ICNG, this would trigger consideration of respite periods and scheduling of works. Where noise is above highly noise affected management levels, respite periods should be considered to restrict 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, or during school holidays 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.

General Measures

Complaints can arise even if the noise and vibration levels comply with the Project limits. To minimise complaints, the following common mitigation measures are recommended:

- Avoid unnecessary noise. This means managing the site to ensure:
 - o No shouting
 - o No unnecessary use of horns
 - o No loud site radios
 - o No rough handling of material and equipment
 - o No banging or shaking excavator buckets
 - o No unnecessary steel on steel contact (e.g. during the loading of scaffolding on trucks)
 - o No high engine revs. This includes choosing the right sized equipment and turning engines off when idle.
 - o Scheduling vehicle deliveries so that there are no trucks waiting in side streets and ensuring that all delivery vehicles are switched off during loading and unloading activities.
- Avoid unnecessary vibration. This means managing the site to ensure:
 - o No unnecessary dropping of heavy objects
 - o No potholes, bumps or corrugations in site accessways
 - o Excavator operators are skilled and use their machines considerately
- Mitigate track squeal from tracked equipment, such as excavators. This may include tensioning and watering or lubricating the tracks regularly
- Locate stationary equipment (e.g. generators) away from noise sensitive receivers and/or screen them behind site buildings and material stores
- Orient mobile machinery to maximise the distance between the engine exhaust and the nearest sensitive building façade (e.g. excavators)
- Utilise specific measures for the following activities:
 - o Excavators
 - o Excavators with hammer
 - o Hand tools

Excavators

All excavators can generate high noise and vibration levels. The actual level they generate depends very much on the experience and temperament of the operator.

- Use the right sized excavator for the job
- Operate the bucket and armature with smooth movements (avoid jerking)
- Tip material from the bucket rather than shaking it clean where practicable
- Avoid hitting the bucket on the ground or dropping heavy objects
- Control the weight shift of the excavator to avoid the tracks lifting and thudding on the ground

Jack hammer & breaker

- Avoid quiet periods of the day
- Minimise the amount of breaking needed (e.g. use a crushing shear or pulveriser attachment in place of a breaker, or use a cut and lift approach to enable breaking offsite)
- Match the size of breaker to the scale of the works. It should be large enough to carry out the work efficiently, but not over-sized (avoiding unnecessary noise and vibration)
- For concrete breaking, make an initial perimeter saw cut at the perimeter to reduce vibration transfer to nearby buildings
- Ensure effective noise mitigation is in place using noise barriers and and/or a breaker blanket
- Minimise the breaking period (e.g. remove larger boulders for breaking offsite), and/or the number of breaking periods (e.g. complete all breaking in one extended period rather than two shorter periods with the same overall duration)
- Match the chisel/tip type to the material and use a dampened bit to avoid ringing
- Avoid 'blank' firing by placing the chisel on the rock or concrete before starting, and minimising firing after it breaks through

Hand tools

- Prioritise use of a tension control bolt, hydraulic wrench or manual torque wrench to minimise rattle gun slippage on a tightened nut

E4 Community Engagement

It is recommended that the following practices relating to community consultation be adopted:

Communication

Before construction

Written communication (e.g. newsletter) will be provided to building occupants identified in this report prior to starting construction. It will include:

- All potentially impacted receivers should be informed, reasonably ahead of time, of the nature of works to be carried out, the expected noise levels from noisier activities and their duration, and the measures being taken to minimise noise from the construction.
- Effective channels of communication must be established between the contractor/developer, Local Authority and affected receivers.
- A site representative responsible for all matters relating to noise should be appointed and contact details of this representative be readily available. A site information board should be installed in front of the construction site with the name and contact details for the site representative.
- Acknowledge that some activities (listed in this document) are predicted to generate high noise and/or vibration levels and may result in disturbance for short periods

During construction

Once construction has begun, ongoing communication is important. Regular communication during the works will include:

- Public site signage that includes contact details
- Details of upcoming activities that may result in disturbance
- Any changes to scheduled timing and duration of activities

- Occupants of buildings identified in this report will be advised at least three days prior to the excavation works commencing.

Complaint response

All construction noise and/or vibration complaints will be recorded in a complaints file that is available to affected parties and Council on request (see Appendix F). For each complaint, an investigation will be undertaken as soon as practicable using the following steps:

- Acknowledge receipt of the concern or complaint and record:
 - o The name, address and contact details of the complainant (unless they elect not to provide)
 - o Time and date the complaint was received and who received it
 - o Time and date of the activity that caused the complaint (estimated where not known)
 - o The complainant's description of the activity and its effects
 - o Any relief sought by the complainant (e.g. scheduling of the activity)
- Identify the relevant activity and review the activity log to verify the complaint (or otherwise)
- If a complaint relates to building damage, inform the on-duty site manager as soon as practicable and stop the relevant works pending an investigation. In most cases, stopping the activity will provide immediate relief. But in some cases, this may not be practicable for safety or other reasons, in which case the complainant will be kept updated regularly during the time it takes to stop the activity.
- Review data from monitoring (if available) to identify the time in question and, if possible, verify exceedance
- Review the predicted noise and/or vibration levels to determine if the activity was identified. Consider attended monitoring to verify the underlying reference level assumptions
- Review the mitigation and management measures in place to ensure they have been applied. Review the relief sought by the complainant. Adopt further mitigation and management measures as appropriate.
- Review the potential residual effects if predicted to continue to exceed the relevant performance standards
- Report the findings and recommendations to the Project Manager, implement changes and update this CNVMP as appropriate
- Report the outcomes of the investigation to the complainant, identifying where the relief sought by the complainant has been adopted or the reason(s) otherwise.

E5 Monitoring

The requirement or otherwise for noise and/or vibration monitoring must be assessed as part of the detailed construction noise assessment based on the appointed main contractors proposed work methods and equipment.

APPENDIX F COMPLAINTS RESPONSE PROCEDURE

In the interest of maintaining good relationships the appointed contractor/developer may adopt the following complaint response procedure:

1. [name of the appointed contractor/developer] will have two main points of contact, (XXXXXX) and (XXXXXX). They will be the responsible people and will be contactable by a dedicated customer service mobile number once the site is live.
2. [name of the appointed contractor/developer] representative who receives the call via the service line, will record the details and the nature of the complaint on the site-specific Customer Service Line Log.
3. [name of the appointed contractor/developer] representative will assess if the problem can be simply resolved by reducing noise levels through implementation of the various work practises detailed in the Construction Noise Management Plan
4. [name of the appointed contractor/developer] representative who receives the call will advise the complainant of the action taken and record all details of the conversation, including the complainants' name, number and nature of complaint.
5. A copy of the Customer Service Line Log will be filed internally with the site's daily reports and will be issued to the Council or relevant authority.

Table H1: Customer Service Line Log

| ITEM | Comments |
|---|----------|
| Date and Time of Call: | |
| Name and location of caller: | |
| Phone number: | |
| Nature of Call: | |
| (If noise complaint, note on-site activities at the time) | |
| Action taken: | |
| Council notified: (Y/N) | |