# Construction Noise and Vibration Management Plan

## Wee Hur Student Housing

**13-23 Gibbons Street, Redfern NSW 2016**

REPORT


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# CONSTRUCTION NOISE MANAGEMENT PLAN

## Activity Schedule

| Date | Revision | Issue | Prepared By | Approved By |
|---|---|---|---|---|
| 14.11.2018 | A | Issued | R. Osman | D.Luck |
| 7.12.2018 | B | Issued | R. Osman | D.Luck |
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# 1. INTRODUCTION

Northrop Consulting Engineers Pty Ltd (Northrop) Acoustics have been engaged by The Trust Company (Australia) Limited ATF WH Gibbons Trust to provide and demolition, excavation and construction noise and vibration management plan for the proposed Student Housing at 13-23 Gibbons Street, Redfern NSW 2016.

A demolition, excavation and construction noise and vibration management plan is a site specific plan developed to ensure that appropriate work practices are implemented during the demolition, excavation and construction to minimise noise and vibration impact. This document provides a construction noise management plan so as to comply with the DECCW Interim Construction Noise Guideline (July 2009) and the Transport for NSW (TfNSW) document “T HR CI 12051 ST – Development Near Rail Tunnels”.

Procedures for neighbouring community engagement and keeping noise and vibration affected neighbouring community informed are addressed in this construction noise management plan. Procedures on dealing with community complaints are also outlined in this construction noise management plan.

Measurement and reporting methodology and the relevant reporting procedures are provided in this construction noise management plan.

# 2. NOISE AND VIBRATION

Northrop Consulting Engineers Pty Ltd (Northrop) Acoustics have been engaged by The Trust Company (Australia) Limited ATF WH Gibbons Trust to provide and demolition, excavation and construction noise and vibration management plan for the proposed Student Housing at 13-23 Gibbons Street, Redfern NSW 2016.

## 2.1 Existing Environment Noise and Vibration

The normal day time noise and vibration environment near the proposed student housing site is primarily influenced by traffic flows, local fauna and industry.

The existing environment is characterised by a mix of commercial, light industrial, recreational areas and residential receivers.

Northrop Consulting Engineers (Northrop) were engaged to undertake a Construction Noise and Vibration Impact Assessment (CNVIA) for the proposal (Appendix E).

An assessment of existing ambient noise levels was undertaken by Northrop. Noise levels were taken in proximity to the study area to characterise the background noise environment at nearest potential noise affected receivers and establish representative construction noise management levels for the proposal (refer to Figure 1 below).

## 2.2 Potential Noise Impacts During Construction

The Interim Construction Noise Guideline (ICNG) outlines that a quantitative assessment must be undertaken where works are likely to affect an individual or sensitive land use for more than three weeks in total.

A specialist CNVIA was undertaken for the proposed construction works. The following activities were undertaken as part of the CNVIA:

- attended and unattended noise monitoring at locations indicative of noise sensitive receivers
- establishment of project specific airborne noise construction goals based on monitored existing noise levels
- prediction of construction noise levels from proposed construction works
- recommendation of environmental noise control options/management practices.

Noise impacts predicted are representative of peak noise generating construction works without implementation of any mitigation measures. As works progress, nearest receivers are anticipated to be less impacted by construction noise as the plant and equipment used during feeder pull, jointing and backfill phases of the joint works have lower noise levels and various mitigation measures would be implemented.

Construction noise is managed in accordance with the EPA Interim Construction Noise Guideline (ICNG, 2009) which provides management objectives for construction noise at non-residential land uses. The ICNG airborne noise goals are to be applied to assess noise impacts and determine the requirement for the reasonable and feasible management of construction noise to minimise potential for disturbance.

Site specific construction noise management levels have been established adopting the measured background noise levels and the ICNG corrections for the time of construction work.

# 3. CONSTRUCTION NOISE & VIBRATION GUIDELINES AND REGULATIONS

Construction noise is one of the major environmental noise issues in NSW – not only from building works but also from demolition, remediation, renewal and maintenance.

Construction can generate high noise levels that can adversely affect:

- sleep
- concentration, and thus learning performance
- mental and physical health.

Construction can occur close to residences or other sensitive land uses and be variable in times of occurrence. These aspects of construction can exacerbate noise levels and their effects. Construction noise by its nature is temporary, may not be amenable to purpose-built noise control measures applied to industrial processes, and may move as construction progresses.

## 3.1 NSW Interim Construction Noise Guidelines

The Protection of the Environment Operations Act 1997 (NSW) Act is the key piece of environment protection legislation, and the Protection of the Environment Operations (Noise Control) Regulation 2008 (NSW) provides for inspection and testing of noise emissions.

The “Interim Construction Noise Guidelines” (published by the NSW Office of Environment and Heritage, 2009) deals with the assessment of noise from construction activities and advises on best practice approaches to minimise noise impacts. It is aimed at managing noise from construction works regulated by Office of Environment and Heritage, and is used to set statutory conditions in licences or other regulatory instruments.

Construction site operators must comply with the following construction noise and vibration control requirements from the Interim Construction Noise Guidelines (2009):

***17 Noise and vibration measures***

*17.1 Construction contractors are to implement the requirements of the DECCW interim Construction Noise Guideline (July 2009)”as far as practicable.*

*17.2 All reasonable, practicable steps are to be undertaken to reduce noise and vibration from the site.*

*17.3 Demolition noise is to be attenuated with the use of screening, acoustic enclosures, engine silencing and substitution by alternative processes to reduce noise emission levels from typical demolition equipment.*

*17.4 Plant and equipment is to be maintained, checked and calibrated in accordance with the appropriate design requirements and to ensure that maximum sound power levels are not exceeded.*

*17.6 Unnecessary noise is to be avoided when carrying out manual operations and operating plant.*

*17.7 Any equipment not used for extended periods is to be switched off.*

*17.8 The use of any rock excavation machinery or any mechanical pile drivers or the like would be restricted to the hours of 8:00am to 5:00pm (maximum) on Monday to Friday only, to minimise the noise levels during construction and loss of amenity to the surrounding area.*

*17.9 Rock breaking, rock hammering, sheet piling, pile-driving and any similar activity is to be scheduled only between the following hours unless otherwise approved:*

- *9am to 12pm, Monday to Friday;*
- *2pm to 5pm, Monday to Friday; and*
- *9am to 12pm, Saturday.*

*17.10 For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, a notification process would be implemented whereby nearby development would be made aware of the time and duration of noise intensive construction processes.*

## 3.2 Vibration guidelines

The "Assessing vibration: A Technical Guideline" (published by the NSW Office of Environment and Heritage, 2006) is based on guidelines contained in BS 6472-1992, and presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. It does not address motion sickness, occupational vibration, blasting vibration effects or vibration-induced damage to buildings or structures.

## 3.3 Transport for NSW (TfNSW) Requirements

The Illawarra Relief rail tunnel passes to the west of the site, approximately parallel with Gibbons Street (in the vicinity of the site). It is understood that the closest edge of the tunnel lies approximately 9 – 10 m from the south-western boundary of the site. The proposed development is required to take this tunnel into consideration.

Transport for NSW (TfNSW) protects rail tunnel infrastructure by defining rail protection reserves around the tunnel. The 'first reserve' comprises the immediate surrounds of the tunnel, and represents the area that shall not be encroached upon by any future construction or development. The 'second reserve' covers areas where future development works have the potential to impact on the performance of the tunnel support elements and operation of the tunnel.

Details regarding the rail reserves, along with general guidelines on allowed construction activities and required protection measures, are provided in TfNSW document T HR CI 12051 ST – "Development Near Rail Tunnels".

It is envisaged that TfNSW will require vibration monitoring before and during the construction phase of the proposed development of the tunnels to assess and monitor the impact of the proposed development on the surrounding tunnels. The extent of assessment and monitoring required is subject to discussion and agreement from TfNSW once final details of the proposed development are known.

In summary, the following are the requirements pertaining to the vibration monitoring at the tunnels, construction vibration control and management, and reporting procedures to the TfNSW.

### 3.3.1 Effects of developments on rail tunnels

Any development that occurs within a distance of 25 m horizontally from first reserve shall consider the vibration on the rail tunnels with an assessment criteria of maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition or maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining.

### 3.3.2 Construction vibration monitoring

During construction, vibration monitoring of works at the tunnel lining shall be conducted with appropriate trigger levels.

If the vibration levels exceed the tolerable limits, then the developer shall modify the construction methodology in such a way that the vibration limits are satisfied.

### 3.3.3 Impacts of rail tunnels on adjacent developments

TfNSW does not accept liability for the generation of noise and vibration from normal railway operations (including track maintenance), or for its transmission into developments above or adjacent to rail tunnels.

When designing developments above or adjacent to rail tunnels, consideration shall be given to operational vibration and ground or structure-borne noise emissions in accordance with Developments Near Rail Corridor and Busy Roads - Interim Guideline, Department of Planning, NSW Government 2008.

### 3.3.4 Vibration Monitoring Plan

A vibration monitoring plan shall be submitted to TfNSW for review and approval before the construction begins.

For the safety of the tunnels and rail infrastructure, the tunnel and tunnel structure performance shall be monitored during construction and to verify the predicted displacements, stress levels in structural elements and vibration levels. The developer shall implement a comprehensive monitoring system that incorporates early warning criteria developed in agreement with TfNSW.

The developer's geotechnical consultant shall assess the monitoring results continually, and submit monitoring assessment reports for TfNSW's review. The tunnel monitoring regime shall be developed and results reviewed by a qualified tunnel engineering consultant.

## 3.4 Construction Vibration Impact on St.Luke's Presbyterian Church and 1 Margaret St

Consideration must be given into potential vibration impacts to nearby heritage items within at least 25 metres of the proposed development, in particular the St.Luke's Presbyterian Church located at the corner of Regent Street and Margaret Street and the residential apartment block name Katia at 1 Margaret Street located at the corner of Gibbons Street and Margaret Street. As the construction activities on the proposed development site will be between 5 metres and 50 metres to the St.Luke's Presbyterian Church and Katia at 1 Margaret Street, the following vibration criteria shall be adopted so that the structural integrity of the church and the residential apartments at Katia are not compromised and church activities and the residences at Katia not impacted by the construction generated vibration.

***Table 1:*** *Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration ($m/s^2$) 1-80Hz*

| Location | Assessment period | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z axis | x & y axis | z axis | x & y axis |
| **Continuous vibration** | | | | | |
| Places of Worship | All Times | 0.020 | 0.014 | 0.040 | 0.028 |
| **Impulsive vibration[1]** | | | | | |
| Places of Worship | All Times | 0.64 | 0.46 | 0.60 | 0.42 |

*Notes: 1. Intermittent vibration can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g. pile drivers and rock breakers) or repetitive sources (e.g. pavement breakers). A maximum of 3 exceedances events are allowed per day.*

## 3.5 Other General Procedures and Guidelines on Noise and Vibration Management

The following are the general procedures and guidelines on noise and vibration management in addition to sections 3.1, 3.2 & 3.3 described above.

What to do during planning:

- Be aware of any noise sensitive neighbours located near the proposed infrastructure (in this case, a church).
- Consult noise sensitive stakeholders (residents and church management) before starting work in the area to identify special needs.
- Door knock affected residents and businesses where noise and vibration impacts are expected to be higher and/or extend for a longer period. Provide information about the project and potential impacts during construction so they know what to expect.
- Conduct property condition (dilapidation) surveys before work begins that is likely to cause vibration. This will help to resolve any future property damage claims.
- Assess the need for temporary noise absorbing walls/barriers to be installed during construction.

What to do during construction:

- Notify affected residents and businesses about the work at least four business days before it is scheduled to start (including site establishment and work compounds). Four clear business days is required for noisy works outside normal operating hours.
- Provide regular updates and maintain communication with highly affected neighbours.
- Provide signage outside the worksite with the 24-hour contact number clearly displayed.
- Respond promptly to complaints. Monitor the number of complaints received.
- Consider using noise or vibration monitoring if there is a risk of vibration damage or that noise limits will be exceeded at the nearest residence and commercial property.
- Ensure work only occurs within standard work hours unless approval has been given by the Sydney City Council to undertake out of hours work and local residents have been notified. This includes all deliveries to site.
- Ensure the construction team complies with respite period requirements where high impact works (e.g. rock breaking) affect someone for more than one week.
- Consider respite accommodation on a case-by-case basis in response to a request from an affected resident.
- Brief the Sydney City Council and provide them with the 24-hour contact number in case people contact council to make a complaint.

# 4. CONSTRUCTION NOISE AND VIBRATION CONTROL

The following section addresses the site-specific construction noise and vibration criteria, measurement procedures and the various noise levels of construction equipment likely to be used at the site.

## 4.1 Standard Hours for Construction Work

The recommended standard hours for construction (including demolition and excavation) work are as follows

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm
- No work on Sundays or public holidays

Section 2.2 of the "DECC Interim Construction Noise Guideline" (2009) specifies five categories of work that might be taken outside the standard hours. The categories relevant to this project are:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads.
- Emergency work to avoid loss of life or damage to property, or to prevent environmental harm.
- Maintenance and repair of public infrastructure where disruption to essential services and/or consideration of worker safety do not allow work within the standard hours.

Blasting during the construction work is not permitted for this project due to the proximity of residences, heritage buildings and railway tunnels below.

## 4.2 Airborne Construction Noise Affecting Nearby Properties

Table 2 below shows an extract from Table 2 of Section 4.1.1 of the "DECC Interim Construction Noise Guideline" (2009) which sets out the management levels for construction noise at residences and nearby properties. The determination of the Rated Background Noise Level (RBL) is shown in Section 4.4 below.

***Table 2**: Extract from Table 2 of Section 4.1.1 of the "DECC Interim Construction Noise Guideline" (2009)*

| Time of day | Management level $L_{Aeq\ (15\ min)}$ * | How to apply |
|---|---|---|
| Recommended standard hours:<br>Monday to Friday 7 am to 6 pm<br>Saturday 8 am to 1 pm<br>No work on Sundays or public holidays | Noise affected<br>RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise.<br>- 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.<br>- 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<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:<br>1. 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<br>2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |

The Interim Construction Noise Guideline (DECC 2009) notes there may be some community reaction to noise from major construction projects where this is more than 10 decibels above the background noise level for work during the daytime. This recognises that construction noise is generally temporary with the community having a slightly higher tolerance for it.

The best management practices involve adopting particular operational procedures that minimise noise while retaining production efficiency. Some common noise reduction strategies include:

- Changing the activity to reduce the noise impact or disturbance (e.g. reorganising the way the activity is carried out).
- Choosing a suitable time — schedule noisy activity to less sensitive times of the day. There are sensitive times of the day for different people, for example, schools during the day, times of religious services, and residences during evenings and night. Where several noisy pieces of equipment are used, their operation should be scheduled to minimise impacts.
- Keeping neighbours informed of a planned noisy activity, its duration and the reasons for the activity. Neighbours may be more accepting of temporary noise if they know when and why the noise is happening, and how long it will last.
- Educating staff and contractors about noise and quiet work practices. This could include signage, for example, some construction sites have signs reminding contractors to consider neighbours and be quiet, and to not start noisy work too early (e.g. before 8.00 am).

Noise can be controlled in the transmission path by using separation distances, barriers and sound absorptive materials.

- Increasing the separation distance (distance attenuation) between the noise source and receiver reduces the noise level. As a rule of thumb, each doubling of the distance from a noise source equates to a reduction of sound pressure level of 6 dB (the inverse square law). This does not apply close to a loud noise source. It may also be affected by wind and temperature inversions for distances over 300 metres between the source and receiver.
- Careful site selection for a new noisy activity can help minimise noise impacts where it is possible to provide adequate separation distances. Taking advantage of topographic features by siting the noisy activity behind a hill can reduce the distance needed to adequately reduce noise levels.
- Barriers are most effective when they are located close to the noise source and block the line of sight between the source and receiver. The amount of noise reduction achieved depends on the height and mass of the barrier and the frequency of the noise (barriers are less effective for low-frequency noise). Noise barriers should have no gaps. Use of absorptive material on the side of the barrier facing the noise source can also help to reduce noise levels by reducing noise reflections.
- Materials commonly used for noise barriers include solid brick walls, concrete blocks or panels, earth mounds, trenches and cuttings. Natural topography and existing buildings can also provide an effective noise barrier and should be considered when developing a new noisy activity. Trees or other vegetation do not provide an effective noise barrier. Some limited attenuation may be gained where trees are densely planted but little attenuation is achieved for low frequencies.
- Sound-absorptive materials reduce the level of reflected sound. They are porous materials such as glass fibre, wool and mineral wool. Thin layers are capable of absorbing only high frequencies, whereas thicker layers can absorb a wider frequency range.

## 4.3 Noise Sensitive Receivers to the Site

The most impacted community during the construction phase of the development at 13-23 Gibbons Street, Redfern are the residents at 1 Margaret Street Redfern and the users of the historic church 118 Regent Street Redfern. Figure 1 below show the relative locations of the nearest affected properties and residences and measurement locations.

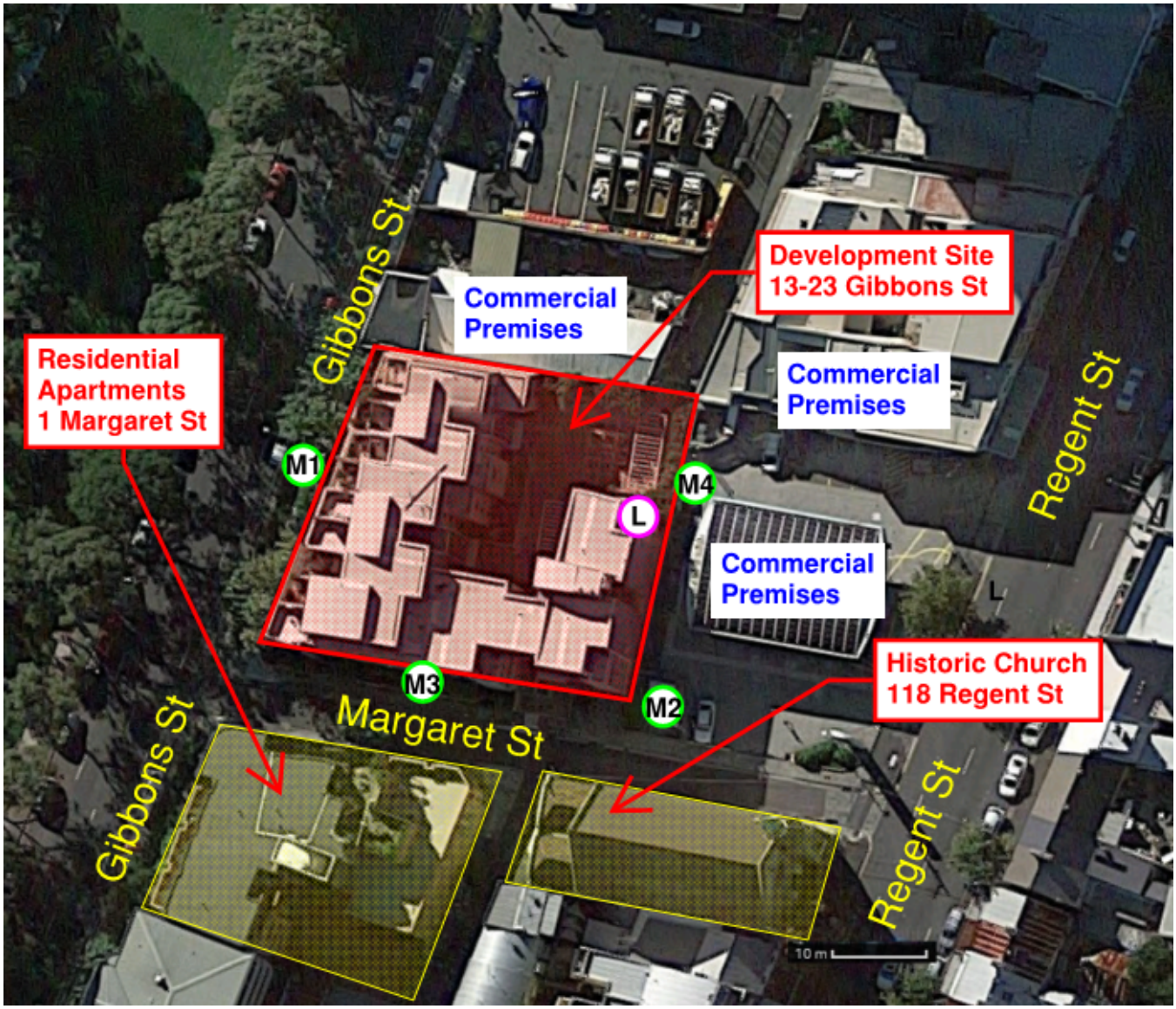


***Figure 1:*** *The proposed development is outlined in red, and the nearest affected residences are outlined in yellow. Long term logger measurement location is marked as* L *in green and operator attended measurements* M1-M4 *in blue.*

## 4.4 Operator attended measurements

Fifteen-minute attended measurements were conducted to verify unattended background noise levels, to establish the octave band noise levels and to characterise the acoustic environment around the site. Operator attended noise measurement survey was conducted with an integrating Type 1 sound level meter and windshield. Measurements were taken continuously and the microphone was set to receive direct frontal sound and facing the direction of sound emission.

The operator attended noise measurements were performed on Thursday 27th September 2018 at locations shown in Figure 1. Results are presented in Table 3 below.

**Table 3: Operator attended acoustic measurements results**

| Measurement | Measurement date and time | $L_{Aeq,\ 15\ minute}$ – dB(A) | $L_{A10,\ 15\ minute}$ – dB(A) | $L_{A90,\ 15\ minute}$ – dB(A) | Notes |
|---|---|---|---|---|---|
| M1 | 27/09/2018 4:05pm – 4:20pm | 76 | 76 | 63 | Traffic noise from Gibbons St |
| M2 | 27/09/2018 4:22pm – 4:37pm | 65 | 67 | 55 | Traffic noise from Gibbons St & Regent St |
| M3 | 27/09/2018 4:38pm – 4:53pm | 64 | 66 | 58 | Traffic noise from Regent St & BP Service Station |
| M3 | 27/09/2018 4:54pm – 5:09pm | 62 | 65 | 56 | Traffic noise from Regent St & BP Service Station |

## 4.5 Long term noise monitoring

Automatic logging noise measurements were performed at the site to document the existing acoustic environment.

Long term noise monitoring was conducted between Wednesday 3rd October 2018 and Wednesday 24th October 2018 at Logger location L1 shown in Figure 1 above.

The results of the automatic logging measurements are shown in Table 4 below.

**Table 4: Long term noise monitoring results**

| Location | Equivalent Continuous Noise Level $L_{Aeq,15min}$ – dB(A) | | | Rating Background Noise Level RBL $L_{A90,15min}$ – dB(A) | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| L | 62 | 61 | 58 | 57 | 53 | 49 |

## 4.6 Noise Criteria at the nearest affected neighbouring properties

The noise criteria derived from the measurements using NSW Noise Policy for Industry methodology at the nearest affected receiver is summarised in the Acoustic Report for Development Application prepared by Northrop Acoustics.

Based on the measurements and assessment undertaken in accordance with the NSW INP, the criteria for the project intrusiveness and amenity noise criteria (in bold) at the nearest affected residential property boundaries at the rear of 1 Margaret Street Redfern and the users of the historic church 118 Regent Street Redfern are shown in Table 5 below.

**Table 5: Project specific noise levels (PSNL)**

| Period | Descriptor | PSNL dB(A) |
|---|---|---|
| **Residential receivers** | | |
| Day (7:00am to 6:00pm) | $L_{Aeq,15min}$ | **60** |
| Evening (6:00pm to 10:00pm) | $L_{Aeq,15min}$ | **50** |
| Night (10:00pm to 7:00am) | $L_{Aeq,15min}$ | **49** |

The project specific noise level at the residential receivers during the day period (7am to 6pm, Monday to Saturday) is 49dB(A). The management trigger level as shown in Table 5 is PSNL + 10 dB $L_{Aeq\ (15\ min)}$ which is 70dB$L_{Aeq\ (15\ min)}$.

## 4.7 Equipment Noise Levels for the Proposed Construction Works

The construction activities associated with the proposed development will consist of various plant and equipment as detailed above. The sound power levels of the noisy plant and equipment likely to be used during the construction works and the periods planned during which the equipment are planned to be used are provided below. The predicted noise levels at the residences at 1 Margaret Street Redfern are based on the 2.4 metre high barriers (described in Section 4.8 below) at the site being in place for the duration of the construction period and shown in Table 6 below. Noise modelling prediction were made in accordance with the AS 1055.3.

**Table 6: Construction equipment & sound pressure levels at 10 metres in dB(A) and at the boundary with Nos.1 Margaret Street (house) and 118 Regent Street (church).**

| Plant description | Typical A-weighted sound power levels $L_{wA}$ dB ref: $10^{-12}$ W | A-weighted sound pressure levels $L_{pA}$ (mid-point) dB at 10 m | A-weighted sound pressure levels $L_{pA}$ (mid-point) dB at 12 m with barrier **(1 Margaret St)** | A-weighted sound pressure levels $L_{pA}$ (mid-point) dB at 15 m with barrier **(118 Regent St)** |
|---|---|---|---|---|
| Asphalt paver | 108 | 80 | 67 | 65 |
| Asphalt rotomill | 111 | 83 | 70 | 68 |
| Backhoe | 104 | 76 | 63 | 61 |
| Backhoe with auger | 106 | 78 | 65 | 63 |
| Bulldozer | 108 | 80 | 67 | 65 |
| Cherry picker | 105 | 77 | 54 | 52 |
| **Compactor** | **113** | **85** | **72** | **70** |
| Compressor (silenced) | 101 | 73 | 60 | 58 |
| Concrete agitator truck | 109 | 76 | 63 | 61 |
| Concrete pencil vibrator | 103 | 75 | 64 | 62 |
| Concrete pump truck | 108 | 80 | 67 | 65 |
| Crane (mobile) | 104 | 76 | 63 | 61 |
| Crane (tower) | 105 | 77 | 64 | 62 |
| Excavator | 107 | 79 | 66 | 64 |
| Filtration unit (40 000 cfm) | 109 | 81 | 64 | 66 |
| Forklift | 106 | 78 | 65 | 63 |
| **Front end loader** | **113** | **85** | **72** | **70** |
| Generator (diesel) | 99 | 71 | 58 | 56 |
| Grader | 110 | 82 | 69 | 67 |
| Hand tools (electric) | 102 | 74 | 61 | 59 |
| **Hand tools (pneumatic)** | **116** | **88** | **75** | **73** |
| Loader (wheeled) | 105 | 77 | 64 | 62 |
| **Machine mounted hydraulic drill** | **113** | **85** | **72** | **70** |
| **Machine mounted percussive drill** | **116** | **88** | **75** | **73** |
| **Machine mounted pneumatic drill** | **116** | **88** | **75** | **73** |
| Piling (bored) | 111 | 83 | 70 | 68 |
| Roller (vibratory) | 108 | 80 | 67 | 65 |
| **Scraper** | **116** | **88** | **75** | **73** |
| Truck (>20 tonne) | 107 | 79 | 66 | 64 |
| **Truck (dump)** | **117** | **89** | **76** | **74** |
| Vehicle (light commercial e.g. 4WD) | 106 | 78 | 65 | 63 |
| Welder | 105 | 77 | 64 | 62 |

The equipment marked in bold above exceeds the 70dBLAeq (15 min)l and construction activities utilising these equipment shall be used between the periods of 9am to 5pm. Outside these periods, additional noise barriers shall be provided around the equipment or specific arrangements are made with the neighbouring residents and church management to conduct work utilising the equipment.

## 4.8 Temporary Sound Barrier Walls

It is recommended that a temporary sound barrier wall (constructed of a minimum of 15 mm thick structural plywood) be erected along development site boundaries on Margaret Street, with the BP service Station and No.11 Gibbons St. The height of the barrier shall be a minimum of 2.4 metre high.

Similar barriers will be required where noisy construction activities are conducted at the higher levels to reduce noise from the site to the apartments on 1 Margaret Street.

## 4.9 Vibration Criteria at Neighbouring Residences and Properties

### 4.9.1 Objectives

The management objective for the site is to limit vibration from construction activities so as to avoid building damage and human discomfort associated with the construction works. It is noted that buildings in the vicinity of development are residential and health buildings. Vibration impacts on the buildings and their occupants should be considered for the assessment of structural damage and human annoyance, respectively.

### 4.9.2 Vibration Sources

Typical vibration levels from construction plant equipment most likely to cause significant vibration are summarised below.

***Table 7:*** *Typical ground vibration generated by construction plant at surface boundaries (excluding tunnels)*

| Activity | Typical ground vibration |
|---|---|
| Bulldozers/ Excavators | Typical ground vibration from bulldozers range from **1mm/s to 2mm/s** at distances of approximately 5m and at distances greater than 20m, vibration levels are usually below 0.2mm/s. |
| Jack Hammers | Typical ground vibrations from jack hammers are generally greater than 5mm/s at distances of 1m and no more than **2mm/s** for distances of 5m or more. |
| Truck traffic | Typical vibration from heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration in the range **0.01-0.2mm/s** at the footings of buildings located 10-20m from a roadway. In general ground vibration from trucks is usually imperceptible in nearby buildings. |

Therefore, vibration management strategies implemented on site shall consider these items of plant and construction activities involving these items of plant.

### 4.9.3 Vibration Criteria

The following criteria are considered applicable when assessing vibration emission levels from the construction works.

The effects of ground vibration on buildings near construction sites may be broadly defined by the following three categories:

1. Disturbance to building occupants - Vibration in which the occupants or users of the building are inconvenienced or possibly disturbed,
2. Effects on building contents - Vibration where the building contents may be affected, and,
3. Effects on building structures - Vibration in which the integrity of the building or structure itself may be prejudiced.

In general, vibration criteria for human disturbance (1) are more stringent than vibration criteria for effects on building contents (2) and building structural damage (3). Hence, compliance with the more stringent limits dictated by Category 1, would allow for compliance to be achieved for the other two categories.

Category 1 – Disturbance to Buildings Occupants

For disturbance to human occupants of buildings, we refer to the DECC's *'Assessing Vibration; a technical guideline'*, published in February 2006. This document provides criteria which are based on the British Standard BS 6472-1992, *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*.

Vibration sources are defined as C*ontinuous, Impulsive or Intermittent.* Section 2 of the technical guideline defines each type of vibration as follows:

> ***'Continuous** vibration continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).*
>
> ***Impulsive** vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.*
>
> ***Intermittent** vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude'.*

The criteria are to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).'*

Preferred and maximum values for continuous and impulsive vibration are defined in below in Table 8 extracted from "Table 2.2 of the guideline" and the values for residential type buildings are reproduced below.

***Table 8:** Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration ($m/s^2$) 1-80Hz*

| Location | Assessment period[1] | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z axis | x & y axis | z axis | x & y axis |
| **Continuous vibration** | | | | | |
| Residences | Daytime (7am-10pm) | 0.010 | 0.0071 | 0.020 | 0.014 |
| Offices | Daytime (7am-10pm) | 0.020 | 0.014 | 0.040 | 0.028 |
| **Impulsive vibration** | | | | | |
| Residences | Daytime (7am-10pm) | 0.30 | 0.21 | 0.60 | 0.42 |
| Offices | Daytime (7am-10pm) | 0.64 | 0.46 | 1.28 | 0.92 |

*Notes: 2. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am*

Intermittent vibration is to be assessed using vibration dose values (VDVs). The VDV method is a fourth power approach which is more sensitive to peaks in the acceleration waveform and makes corrections to the criteria based on the duration of the source's operation. The VDV can be calculated using the overall weighted rms acceleration of the vibrating source in each orthogonal axis and the total period during which the vibration may occur. Weighting curves are provided in each orthogonal axis in the guideline. Preferred and maximum VDV values are defined in Table 9 below extracted from "Table 2.4 of the guideline" and VDV values for residential type buildings are reproduced below.

***Table 9:*** *Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$)*

| Location | Daytime (7am-10pm) [1] | | Night-time (10pm-7am) [1] | |
|---|---|---|---|---|
| | Preferred values | Maximum values | Preferred values | Maximum values |
| Residences | 0.20 | 0.40 | 0.13 | 0.26 |
| Offices | 0.40 | 0.80 | 0.40 | 0.80 |

*Notes: 1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am*

### 4.9.4 Buffer Distances for Vibration Control

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (eg dimensions, materials, type and quality of construction and footing conditions). The intensity, duration, frequency content and number of occurrences of a vibration, all play an important role in both the annoyance caused and the strains induced in structures.

As the pattern of vibration radiation is very different to the pattern of airborne noise radiation, and is very site specific, below are some indicative minimum 'buffer' distances determined for some common construction plant with data available from recent projects, which assist to avoid human discomfort in terms of perceptible (or tactile) vibration during daytime construction hours:

***Table 10:*** *Recommended Minimum Buffer Distances for Construction Plant*

| Plant Item | Recommended Minimum Buffer Distance (m) |
|---|---|
| CFA (Continuous Flight Auger) Piling rig | 10 |
| Excavators | 10 |
| Jack hammers | 5 |

From the above table the nearest receivers are less than 10m from the site, and as such, vibration may cause discomfort to occupants during piling activities. Therefore, site specific buffer distances should be determined for piling activities once vibration emission levels are measured from the piling rig prior to the commencement of its regular use on site.

### 4.9.5 Vibration limits for rail tunnels

For this development which is within a distance of 25 m horizontally from first reserve shall consider the vibration on the rail tunnels with an assessment criteria of maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition or maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining. Vibration monitoring and reporting shall be in accordance with the Transport for NSW (TfNSW) document "T HR CI 12051 ST – Development Near Rail Tunnels".

### 4.9.6 Vibration Management Measures

Further to buffer distances, to ensure vibration impacts are minimised during the construction period, the following vibration management control measures are provided:

1. The proper implementation of a vibration management plan is required to avoid adverse vibration disturbance to affected occupancies. Consultation with occupants and property owners is recommended and should be aimed at providing a communication path directly to the contractor.

2. A management procedure will be implemented to deal with vibration complaints. Each complaint will be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences
3. Where vibration is found to be excessive, management measures shall be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller units, establishment of safe buffer zones and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.

# 5. COMMUNITY ENGAGEMENT DURING CONSTRUCTION

## 5.1 Neighbouring Community Engagement

As a project moves towards the site preparation and construction phase more details normally becomes available on the planned work methods, location of plant and equipment, and scheduling. For the development construction works, contact with the nearest affected community is desirable once approval has been given to commence works and should be undertaken prior to any work beginning. The type of community engagement should relate to the likelihood and extent of noise and vibration impacts from the construction works.

The aim of community engagement is to:

- establish good working relationships between the developer, builder, the community and other stakeholders in relation to the construction project
- receive feedback on the project's environmental performance, discuss community concerns and identify opportunities for the resolution of community complaints and concerns
- gain advice on how best to communicate relevant information on the project and its environmental performance to the broader community
- work cooperatively towards outcomes of benefit to the project, immediate neighbours and the local and regional community.

The Building Contractor shall nominate one of its staff as a community liaison officer for the project as a point of contact for the community regarding issues related to the construction of the development, including issues relating to noise and vibration. The secondary contact for the nearest affected community and other members of the public would be the site manager of the site. Any formal complaints received regarding noise and vibration matters at the construction site shall be passed on to the Building Contractor for the complaints to be addressed and resolved.

## 5.2 Keeping the Noise Affected Community Informed

Being up-front with the noise affected community from the outset can assist in transferring information to the affected community. An example of being up-front is to present noise and vibration related information on the construction works to noise affected community before commencing works. The most noise sensitive properties likely to be most affected by site works and the operation of plant machinery particularly during the demolition and excavation phases are the residents at 1 Margaret Street and the church at 118 Regent Street.

## 5.3 Dealing with Community and public complaints

Complaints from the community and public can arise when accidental or unintentional noise and/or vibration are generated due to unforeseen circumstances or error of judgement made by the construction team. The community and public are generally understanding when this happens once or not too often. The complaints must be handled in a serious and respectful way. The complaints should be recorded and logged in a noise and vibration complaints log book and followed up by the site manager.

Following resolution of the noise or vibration problem, the complainant should be informed of the remedial actions taken before the complaint can be recorded as being resolved.

# 6. TRAINING

The site manager shall implement appropriate training and induction in the requirements of this construction noise management plan. All employees, contractors and utility staff working on site will undergo site induction training which includes Environmental Due Diligence Training. The induction will address:

- This Construction Noise Management Plan
- The Transport for NSW (TfNSW) Construction Vibration Controls Requirements
- The existence of noise legislation and what this means for the project, i.e. OEH and Noise Management Levels
- Delivery hours and locations.
- Reporting and recording environmental incidents related to noise and vibration.
- Noise and vibration minimisation measures.
- The importance of regular maintenance noise and vibration generating plant.

Records will be kept of all personnel undertaking the site induction and training, including the contents of the training, date and name of trainer/s.

Key staff will undertake more comprehensive training relevant to their position and/or responsibility. This training may be provided as “toolbox” talk training.

# 7. APPENDIX A – TYPICAL SOUND LEVELS FROM CONSTRUCTION, MAINTENANCE AND DEMOLITION PLANT NOISE & VIBRATION

The noise generated by machinery such as construction, maintenance and demolition plant may be expressed in terms of the A-weighted sound pressure level measured at some distance from the machine, or in terms of the A-weighted sound power level. The table below extracted from the Australian Standard "AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites" lists typical construction plant and equipment and the range of sound power levels and mid-point sound pressure levels at 10 metres.

(from Appendix A - AS 2436-2010)

| Plant description | A-weighted sound power levels $L_{wA}$ dB ref: $10^{-12}$ W | | A-weighted sound pressure levels $L_{pA}$ (mid-point) dB at 10 m |
|---|---|---|---|
| | Typical or Range | Typical (mid-point) | |
| Asphalt paver | 103-112 | 108 | 80 |
| Asphalt rotomill | 111 | 111 | 83 |
| Backhoe | 100-108 | 104 | 76 |
| Backhoe with auger | 100-111 | 106 | 78 |
| Bulldozer | 102-114 | 108 | 80 |
| Cherry picker | 105 | 105 | 77 |
| Compactor | 110-115 | 113 | 85 |
| Compressor (silenced) | 93-110 | 101 | 73 |
| Concrete agitator truck | 107-111 | 109 | 76 |
| Concrete pencil vibrator | 101-105 | 103 | 75 |
| Concrete pump truck | 103-113 | 108 | 80 |
| Concrete saw | 112-122 | 117 | 89 |
| Concrete vibratory screed | 115 | 115 | 87 |
| Crane (mobile) | 95-113 | 104 | 76 |
| Crane (tower) | 105 | 105 | 77 |
| Excavator | 97-117 | 107 | 79 |
| Filtration unit (40 000 cfm) | 109 | 109 | 81 |
| Forklift | 106 | 106 | 78 |
| Front end loader | 110-115 | 113 | 85 |
| Generator (diesel) | 84-113 | 99 | 71 |
| Grader | 105-115 | 110 | 82 |
| Gritblaster (grit & nozzle air noise) | 129 | 129 | 101 |
| Hand tools (electric) | 95-110 | 102 | 74 |
| Hand tools (pneumatic) | 114-117 | 116 | 88 |
| Jack hammers | 121 | 121 | 93 |
| Loader (wheeled) | 99-111 | 105 | 77 |
| Machine mounted hydraulic drill | 110-115 | 113 | 85 |
| Machine mounted percussive drill | 116 | 116 | 88 |
| Machine mounted pneumatic drill | 110-121 | 116 | 88 |
| Piling (bored) | 111 | 111 | 83 |
| Piling (impact sheet) (Lmax) | 126-147 | 137 | 109 |
| Piling (vibratory) | 116-133 | 125 | 97 |
| Rock breaker | 118 | 118 | 90 |
| Roller (vibratory) | 103-112 | 108 | 80 |
| Scraper | 116 | 116 | 88 |
| Spreader | 95 | 95 | 67 |
| Truck (>20 tonne) | 107 | 107 | 79 |
| Truck (dump) | 117 | 117 | 89 |
| Truck (water cart) | 106-108 | 107 | 79 |
| Vehicle (light commercial e.g. 4WD) | 100-111 | 106 | 78 |
| Welder | 100-110 | 105 | 77 |

# 8. APPENDIX B – NOISE & VIBRATION RELATED ACRONYMS AND GLOSSARY

ABL - The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level ($L_{A90}$) for each period.

DECCW NSW - Department of Environment, Climate Change and Water (see OEH below).

DP&I NSW - Department of Planning and Infrastructure (formerly DOP).

EPL - Environmental Protection Licence, issued by OEH.

$L_{A1}$ - The $L_{A1}$ level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the LA1 level for 99% of the time.

$L_{A10}$ - The $L_{A10}$ level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the $L_{A10}$ level for 90% of the time. The $L_{A10}$ is a common noise descriptor for environmental noise and road traffic noise.

$L_{Aeq}$ - The equivalent continuous sound level ($L_{Aeq}$) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

$L_{A50}$ - The $L_{A50}$ level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the $L_{A50}$ level for 50% of the time.

$L_{A90}$ - The $L_{A90}$ level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the $L_{A90}$ level for 10% of the time. This measure is commonly referred to as the background noise level.

$L_{Amax}$ - The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

$L_{pA}$ dB - The A-weighted sound pressure measured at a particular location referenced to 20 µPa.

$L_{wA}$ dB - The A-weighted sound power generated by a machine or plant referenced to $10^{-12}$ W.

OEH - Office of Environment and Heritage (formerly DECCW)

RBL - The Rating Background Level for each period is the median value of the ABL values for the period over all the days measured. There is therefore an RBL value for each period – daytime, evening and night time.