



MARSHALL DAY
Acoustics 

**BALLINA COAST HIGH SCHOOL
CONSTRUCTION NOISE AND VIBRATION
MANAGEMENT PLAN**

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Project: **BALLINA COAST HIGH SCHOOL**

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EXECUTIVE SUMMARY

Marshall Day Acoustics has been engaged by EJE Architecture to prepare a construction noise and vibration management plan for demolition, piling and construction works associated with the proposed re-development of Ballina High school, Ballina, NSW.

Construction noise criteria have been derived in accordance with the requirements of the EPA Interim Construction Noise Guideline (ICNG) and the best practises of AS 2436-2010. Construction vibration criteria applicable to this site have been determined in accordance with the requirements of the EPA's *Assessing vibration: a technical guideline*.

Noise levels from construction activities have been calculated at the nearest noise sensitive receivers for the various phases of construction. The predicted levels from the proposed demolition and construction (finishes) phase activities indicate that average noise from typical activities are likely to be below both the 'noise affected' levels and the 'highly noise affected' levels at all residential receivers during standard ICNG hours.

Average noise levels from site activity during the construction (structure) and piling/shoring phase are predicted to be below the "highly affected" noise levels and marginally (2 dB and 1 dB respectively) over the "noise affected" levels for residential receivers during typical site activities.

Average noise levels at the St Francis Xavier School and Masonic Centre have been predicted to be up to 13dB above the external noise management levels. It should be noted that as background noise levels for the area have been estimated in accordance with *AS 1055.2-1997*, in practise existing noise levels due to traffic in the area may be above that estimated and may mask the construction noise to some extent.

Noise control recommendations have been provided, including the installation of boundary hoarding and the use of mobile noise barriers for static equipment or significant noise generating equipment where practical.

Predicted vibration levels from piling activity have been calculated. It should be noted that levels are based on a percussive rock hammer and DIPPS system. Levels from the proposed drop hammer and timber pile system are likely to be lower in magnitude.

A construction noise management plan has been detailed with a discussion of practicable noise mitigation measures and management practices to assist in mitigating noise impacts on sensitive receivers.

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1.0 INTRODUCTION

Redevelopment works are proposed at the existing Ballina High School located at 37-49 Swift Street, Ballina, NSW. The redevelopment will include the demolition of existing site buildings and ground up construction of new facilities.

The NSW Department of Planning has requested that a Construction Noise and Vibration Management Plan (CNVMP) be submitted as part of the development application for the project. The assessment should be prepared in accordance with the Environment Protection Authority's Interim Construction Noise Guideline and Assessing Vibration documents to address the potential noise impact during the demolition and construction phases of the redevelopment.

On this basis Marshall Day Acoustics Pty Ltd (MDA) has been engaged to carry out an assessment of construction noise and vibration impacts associated with the redevelopment according to:

- *Interim Construction Noise Guideline*, NSW Environment Protection Authority (EPA)
- *Assessing Vibration: A Technical Guide*, Department of Environment and Conservation, NSW.

This report is based on measurements and calculations conducted by MDA in addition to:

- Architectural drawings as issued by EJE Architecture on 8 September 2016
- Assumed typical construction methodology, demolition activities and plant details formulated based on past project experience.

Acoustic terminology used throughout this report is detailed in Appendix A.

As information regarding the equipment schedule and site planning during the various phases of work is not readily available, MDA has made assumptions based on prior experience on similar projects and construction scopes. It should be noted that any significant deviation from the equipment schedule and site planning detailed in this report may render the presented findings and recommendations obsolete.

MDA recommends that once a builder has been engaged and more information regarding the equipment schedule is known, the CNVMP should be reviewed and, if appropriate, revised to reflect the known schedule and site planning. Noise levels arising from operation under a finalised schedule should continue to be managed in accordance with the goals in this report.

2.0 SITE DESCRIPTION

The Ballina High School site is located at 37-49 Swift Street, Ballina, NSW.

The site is bounded by:

- Swift Street to the south
- Cherry Street to the west
- Martin Street to the east
- Further playing fields related to the school to the north

Redevelopment of the site will comprise the demolition of several existing buildings and the construction of a new high school building incorporating a performance theatre, sports hall, music practise and recording studios, and construction, wood and metal workshops.

The nearest affected occupancies are detailed in Table 1 and have been selected to be representative for the purpose of our assessment and calculations. The land use for each receiver has been described in accordance with the sensitive land uses detailed in the IGNG.

Table 1: Representative occupancies

Receiver No.	Location	Land Use	Description
1	64 Cherry Street	Residential	Detached house over Cherry Street
2	62 Cherry Street	Commercial	Takeaway restaurant over Cherry Street
3	60 Cherry Street	Residential	Detached house over Cherry Street
4	56 Cherry Street	Place of Worship ¹	Masonic Centre
5	St Francis Xavier School	School	High School and recreation fields
6	36 Swift Street	Residential	Detached house over Swift Street
7	31 Martin Street	Residential	Detached house over Martin Street
8	33 Martin Street	Residential	Detached house over Martin Street
9	35 Martin Street	Residential	Detached house over Martin Street
10	37 Martin Street	Residential	Detached house over Martin Street
11	39 Martin Street	Residential	Detached house over Martin Street

¹ The land use “Place of Worship” is assumed to best represent activities in the Masonic Centre



Figure 1: Subject site and nearby representative occupancies

It is assumed that demolition and construction activities on-site will comply with the recommended standard hours for construction work on-site, as described in the ICNG:

- Monday to Friday 0700hrs to 1800hrs
- Saturday 0800hrs to 1300hrs
- No work on Sundays or public holidays

3.0 BACKGROUND NOISE LEVELS

As MDA has not been engaged to conduct a background noise survey,, background noise levels for the site have been assumed based on the estimated average background sound pressure levels presented in *AS 1055.2-1997 Acoustics - Description and measurement of environmental noise - General procedures*.

The estimated average background sound pressure levels for the area are presented in Table 2.

Table 2: Estimated average background sound pressure levels for the subject area as per AS 1055.2-1997

Noise area category	Description of neighbourhood	Average background sound pressure level, L_{A90} dB		
		Monday to Saturday ¹		
		0700-1800	1800-2200	2200-0700
R2	Areas with low density transportation	45	40 ²	35 ²

¹ Only estimated levels for Monday to Saturday have been presented as it is assumed no site works will occur on Sundays or public holidays

² Estimated average background sound pressure levels have been presented for the Evening and Night periods for information only. It is assumed site work will be restricted to the ICNG recommended standard hours detailed in Section 2.0.

4.0 CONSTRUCTION NOISE & VIBRATION CRITERIA

4.1 Construction noise criteria

Construction noise criteria have been derived based on the estimated average background levels presented in Table 2. The noise criteria for the permitted hours of construction are summarised in Table 3 below with full derivation of the criteria set out in Appendix B.

Table 3: Construction noise management levels

Receiver	Type	Time of day	"Noise Affected" management level, dB $L_{Aeq, 15min}$	"Highly noise affected" management level, dB $L_{Aeq, 15min}$	External Noise Level, dB $L_{Aeq, 15min}$
1, 3, 6, 7, 8, 9, 10, 11	Residential	Mon-Fri 0700-1800hrs	65	75	---
		Sat 0800-1300hrs	65	75	---
2	Commercial	Mon-Fri 0700-1800hrs	---	---	70
		Sat 0800-1300hrs	---	---	70
4	Place of Worship	Mon-Fri 0700-1800hrs	---	---	55 ¹
		Sat 0800-1300hrs	---	---	55 ¹
5	School (classroom)	Mon-Fri 0700-1800hrs	---	---	55 ¹
		Sat 0800-1300hrs	---	---	55 ¹
5	School (playing fields)	Mon-Fri 0700-1800hrs	---	---	60
		Sat 0800-1300hrs	---	---	60

¹ The external noise level applicable to these receivers has been derived by taking the internal noise level of 45 dB $L_{Aeq(15\text{ min})}$ as stipulated in the ICNG and adding 10dB to account for the likely performance of the receiver facade

The “noise affected” level is the point above which there may be some community reaction to noise”. The “highly noise affected” level represents the point 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.

4.2 Construction vibration criteria

The EPA Interim Construction Noise Guideline refers assessment of vibration effects on people to the EPA document *Assessing vibration: A technical guideline*. For assessment of vibration effects on structures the German standard DIN4150-3 *Structural vibration – Effects of vibration on structures - 1999* is used.

4.2.1 Vibration limits – Effects on structures

DIN 4150-3 provides guidelines to use when evaluating the effects of short-term vibration on structures. The guideline vibration limits, as reproduced from the standard, are detailed in .

Table 4: Vibration limits according to DIN 4150: Peak Particle Velocity (PPV) mm/s

Line	Type of structure	Vibration at the foundation of building, at a frequency of			Vibration in horizontal plane of highest floor, at all frequencies
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz and above	
I	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
II	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
III	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines I and II and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8

Experience has shown that if the guideline values of are complied with, damage which reduces the serviceability of the building will not occur.

4.2.2 Vibration limits – Effects on people

As the DIN standard is commonly accepted by industry, the criterion of 5mm/s PPV for dwellings is considered appropriate for this assessment.

The EPA document *Assessing vibration: A technical guideline*, provides a vibration dose value (VDV) criteria to assess the severity of intermittent vibration, such as that experienced from construction activities. The VDV criteria for residential receivers as detailed in the guideline are provided in Table 5 below.

Table 5: Acceptable vibration dose values for intermittent vibration

Receiver type	Day-time ¹	
	Preferred value	Maximum value
Residences	0.20	0.40
Offices	0.40	0.80

¹ 16 hour day period 0600-2200hrs.

The preferred values indicate a low probability of adverse comment, and the maximum values indicate that adverse comments may be expected.

5.0 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

There are several noise sources associated with the different phases of construction that have the potential to increase noise at the nearest noise sensitive receivers. A list of proposed equipment involved in the demolition, excavation and general construction phases of the redevelopment are presented. A schedule of anticipated activities and equipment for each construction phase has been provided by the client as stated below in Table 6 below.

Table 6: Anticipated activities and equipment schedule

Phase	Activities	Equipment
Demolition & site preparation	Concrete removal	1 x 12t excavator 1 x 22t excavator Jack hammer & breaker Concrete saw/ring saw
	Removal of waste material from site	Bogie truck, no trailer
	General	Generator Air compressor & lines
Piling & shoring	Piling activities	Concrete truck & pump 1 x 12t excavator 1 x Drop hammer piling rig (approx 23m depth and 0.4m diameter), 4t hammer 1m drop Jack hammer & breaker Concrete saw/ring saw
	Delivery of materials & removal of waste materials	Bogie truck

	General	Generator Air compressor & lines De-watering plant
Construction – Structure	Concreting	Concrete pump 1 x tower crane Exhaust fans Brick saw Concrete vibrator Concrete floats Concrete saw/ring saw Diamond core drill Nail guns Hydraulic bar cutter
	Delivery of materials	Concrete truck Bogie truck
	General	Generator Air compressor & lines De-watering plant Pressure cleaner Electric winch & materials hoist
Construction – Finishes	Construction activities	1 x tower crane Exhaust fans Diamond core drill Brick saw Scissor lift Nail guns Hydraulic bar cutter
	Delivery of materials	Flatbed truck
	General	Generator Air compressor & lines De-watering plant Pressure cleaner Electric winch & materials hoist

Our assessment of noise levels from the construction is summarised below. Refer to Appendix C for our detailed assessment. Noise levels associated with each noise source are detailed in Appendix D.

5.1 Noise control recommendations

MDA recommends the noise control recommendations detailed in Table 7 overleaf are implemented on-site. Our calculations include the effect of these recommendations.

Table 7: Noise control recommendations for site

Phase	Equipment/Location	Recommendation
Demolition	Jack hammer & breaker	- Localised noise barriers should be utilised when this equipment is in use.
	Concrete saw/ring saw	- Barriers should be mobile and extend to a height 1m above noise source.
	Generator	- Barrier should envelope the work location to ensure no direct line of site to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Site boundary	Solid hoarding of minimum 2m height
Piling/shoring	Jack hammer & breaker	- Localised noise barriers should be utilised when this equipment is in use.
	Concrete saw/ring saw	- Barriers should be mobile and extend to a height 1m above noise source.
	Generator	- Barrier should envelope the work location to ensure no direct line of site to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Drop hammer piling rig	Use resilient pad (dolly) between pile and hammerhead, e.g. 2 layers of non-flammable cloth stuffed with glass fibre or mineral wool and protected by plywood. Packing should be kept in good condition.
	Site boundary	Solid hoarding of minimum 2m height
Construction (structure)	Core drill	- Localised noise barriers should be utilised when this equipment is in use.
	Concrete saw/ring saw	- Barriers should be mobile and extend to a height 1m above noise source.
	Generator	- Barrier should envelope the work location to ensure no direct line of site to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Site boundary	Solid hoarding of minimum 2m height
Construction (finishes)	Core drill	- Localised noise barriers should be utilised when this equipment is used.
	Concrete saw/ring saw	- Barriers should be mobile and extend

Phase	Equipment/Location	Recommendation
		to a height 1m above noise source. - Barrier should envelope the work location to ensure no direct line of site to nearby receivers. - Practical and feasible measures should be taken to allow the noise barrier to be located within 4m of the noise source.
	Site boundary	Solid hoarding of minimum 2m height

5.2 Summary of findings

5.2.1 Construction Noise

The predicted L_{Aeq} levels from the proposed construction equipment indicate that average noise from typical demolition, piling and construction activities may exceed the “noise affected” goals from the EPA criteria at some receiver locations.

Within standard ICNG hours (Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs) the average noise levels from typical operations would be;

- Demolition activities are calculated to be:
 - o Below “noise affected” goals at all residential receivers
 - o up to 5 dB above external noise limits at all other receivers
- Piling activities are calculated to be:
 - o up to 1 dB above “noise affected” goals at residential receivers
 - o up to 12 dB above external noise limits at all other receivers
- Construction (structure) activities are calculated to be:
 - o up to 2 dB above “noise affected” goals at residential receivers
 - o up to 13 dB above external noise limits at all other receivers
- Construction (finishes) activities are calculated to be:
 - o Below “noise affected” goals at all residential receivers
 - o up to 8 dB above external noise limits at all other receivers

These exceedances are typical of construction sites in residential areas. Further, since all construction work is restricted to take place only during the daytime, noise impacts will not be experienced during the most sensitive time period i.e. night-time.

It is not expected that the “highly noise affected” levels will be exceeded at any residential receivers during typical operations.

The dominant noise sources for each phase of construction are indicated in Table 8 overleaf.

Table 8: Dominant noise generating equipment

Phase	Dominant noise generating equipment
Demolition	Jack hammer, bogie truck, concrete saw/ring saw
Piling and shoring	Jack hammer, bogie truck, drop hammer piling rig
Construction (structure)	Tower crane, concrete truck, bogie truck, concrete saw/ring saw, electric winch
Construction (finishes)	Tower crane, flatbed truck, hydraulic bar cutter

During typical operation within guidance hours, the “noise affected” management goals may be marginally exceeded at residential receivers by up to 2dB. For “worst case” operations the “noise affected” management goals may be exceed by up to 7dB for short periods of time.

Additionally, the external noise limits will likely be exceeded at the Masonic Centre and St Francis Xavier High School during both typical and worst case operation. This indicates that reasonable mitigation measures will need to be considered, in addition to those proposed in Section 5.1, to minimise the impact from construction noise. Community consultation and negotiation may be required. Notification should be provided of the proposed construction activities to nearby residents and non-residential receivers.

We do note that the existing noise levels due to traffic in the area may be above that estimated in Section 3.0 and may mask the construction noise to some extent.

5.2.2 Construction Vibration

The most significant source of vibration during all phases of the proposed works will be the operation of the drop hammer and timber pile system.

Measured vibration data for a drop hammer and timber pile system is not readily available. For the purposes of assessment completeness, source vibration data for 170mm diameter Ductile Iron Pipe Piles (DIPPS) driven into the ground using a modified percussive rock hammer has been used. This represents the most readily available vibration data at this time and is expected to be greater in magnitude when compared to a drop hammer and timber pile system.

Based on the distance to the nearest sensitive receiver, vibration levels have been calculated for a DIPPS piling scenario and the assessment is presented against applicable criteria in Table 9 below.

Table 9: Assessment of vibration levels for DIPPS piling scenario

Assessment Description	Predicted level at nearest sensitive receiver	Criteria	Comment
Effects on Structures DIN 4150	2-3 mm/s PPV at foundation *	5 mm/s PPV	Low probability of reducing serviceability of building
Effects on People EPA	0.3 to 0.4 VDV**	0.4 VDV	Low probability for adverse comment

* Based on the maximum vibration expected during piling

** Based on 2-3 hours of continuous piling per 10 hour day period

Table 9 shows that piling vibration is not expected to result in building damage or adverse comment at/from the nearest sensitive receiver for the conservative scenario involving 2-3 hours of continuous DIPPS piling per day.

Taking into account the lower magnitude of vibration events expected with the drop hammer and timber pile system, and incorporating the piling control recommendations detailed in Table 7 (the

use of a resilient pad between the drop hammer and timber pile), continuous piling for longer than 2-3 hours per day may be possible, however we note that at all times, the community should be engaged to ensure that any reported impacts can be managed effectively and efficiently.

6.0 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

6.1 Community consultation and negotiation

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

- All potentially impacted residents 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 should 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.

6.2 Scheduling of activities and providing respite periods

- Scheduling high noise-generating activities to be undertaken when background noise, including local road traffic, is high to provide masking to construction noise.
- All building, demolition and site work, including site deliveries are restricted to Monday to Friday (7.00am to 5.00pm), Saturday (8.00am to 1.00pm) and not any time on Sunday & public holidays as per the recommended standard hours detailed in the ICNG.
- Excavating of rock, and the use of jack-hammers, pile-drivers, vibration rollers/compactors or the like represent dominant noise sources on site, and their use during the weekend period may give rise to adverse noise impacts. In order to mitigate noise from these sources, the scheduling of site work to concentrate these activities during the weekday periods is advisable, where practical and feasible.
- Ensuring that periods of respite are provided when noisier activities such as excavation take place. Respite periods may be provided by restricting the hours in which the noisiest activities can take place.
- Respite periods may also need to be provided in response to complaints from affected receivers.

6.3 Management work practices

- Planning deliveries and access to the site to occur quietly and efficiently. Truck drivers must be kept informed of designated entry and egress points, parking locations and acceptable delivery hours. Vehicle movements outside standard construction hours should be avoided where possible.
- 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 where close to residences.

6.4 Construction noise control measures

Predicted noise levels take into account the proposed boundary hoarding and mobile noise barriers detailed in Section 5.1.

The effect of hoarding at all boundaries has been taken into account in the noise calculations. If solid hoarding is not constructed, noise levels at the affected receivers will likely be in the range of 5-10dB

higher than predicted and will exceed the “noise affected” goals at several residential receivers during typical site operation.

It is envisaged that a variety of additional practicable noise control measures may be employed:

- Using existing structures and temporary site structures and material stockpiles as noise barriers
- Reducing the line-of sight from noise source to receiver through erection of barriers as necessary around static, high noise items such as compressors and preferentially locating on-site to use the retained building (if applicable) as shielding
- Where practicable, installing broadband noise reversing alarms as an alternative to common ‘beeper’ alarms for on-site vehicles and vehicles that regularly visit the construction site
- Siting of noisy plant as far away from sensitive properties as permitted by site constraints

6.5 Complaint handling procedure

- The site representative responsible for matters relating to noise will be responsible for handling complaints and will need to be readily accessible to give complaints a fair hearing should they arise.
- All feasible and reasonable measures will need to be applied to address the source of complaint.
- A register of all complaints will need to be maintained documenting the nature of complaints and the procedures applied to resolve the complaint. All complaints should be responded to and a record kept of actions taken to address the issues. All complaints should be followed up after the implementation of any controls to identify whether the complaint has been adequately resolved.

APPENDIX A GLOSSARY OF TERMINOLOGY

SWL or L_w	<p><u>Sound Power Level</u> 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> The unit of sound level. 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>
dB(A)	<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. 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}	<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>
L_{Amax}	<p>The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.</p>
L_{Aavmax}	<p>The A-weighted sound pressure level obtained by arithmetically averaging the maximum levels measured during the time period considered.</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. 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).</p>
PPV	<p>Peak Particle Velocity For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.</p>
VDV	<p>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.</p>

APPENDIX B CONSTRUCTION NOISE CRITERIA

The NSW EPA Interim Construction Noise Guideline (ICNG) provides guidance for assessing noise associated with construction activities. The ICNG sets out management levels above which there may be community reaction to construction noise. A “noise affected” level is derived which is a level above which there may be some community reaction to noise”. A “highly noise affected” level is also nominated for residents, which “represents the point above which there may be a strong community reaction to noise”.

The noise management levels for residential receivers affected by construction noise are derived from a combination of background noise levels, referred in the ICNG as rating background levels, RBL, and the time period at which the construction work occurs.

The CNG sets out recommended standard hours for construction work, these are:

- Monday to Friday 0700-1800hrs
- Saturdays 0800-1300hrs
- No work on Sundays or public holidays

The ICNG “noise affected” management level can then be derived by addressing the RBL values and hours at which construction work occurs; by adding 10dB for work during the recommended hours or adding 5dB outside these recommended hours.

The “highly noise affected” level for residents is 75dB LAeq,15mins.

As an acoustic site survey has not been conducted, background noise levels for the site have been assumed based on the estimated average background sound pressure levels presented in *AS 1055.2-1997 Acoustics - Description and measurement of environmental noise - General procedures*.

The rating background level, RBL, during the day time period, 0700-1800hrs, was estimated to be 45dB L_{A90(period)}.

The construction noise management levels for residential receivers nominated in Table B 1 that will be impacted during the construction phases of this project are provided in Table B 2 overleaf.

Table B 1: Residential receiver locations

Receiver No.	Location	Land Use	Description
1	64 Cherry Street	Residential	Detached house over Cherry Street
2	62 Cherry Street	Commercial	Takeaway restaurant over Cherry Street
3	60 Cherry Street	Residential	Detached house over Cherry Street
4	56 Cherry Street	Place of Worship ¹	Masonic Centre
5	St Francis Xavier School	School	High School and recreation fields
6	36 Swift Street	Residential	Detached house over Swift Street
7	31 Martin Street	Residential	Detached house over Martin Street
8	33 Martin Street	Residential	Detached house over Martin Street
9	35 Martin Street	Residential	Detached house over Martin Street
10	37 Martin Street	Residential	Detached house over Martin Street
11	39 Martin Street	Residential	Detached house over Martin Street

¹ The land use “Place of Worship” is assumed to best represent activities in the Masonic Centre

Table B 2: Construction noise management levels for representative receivers

Receiver	Type	Time of day	“Noise Affected” management level, dB $L_{Aeq, 15min}$	“Highly noise affected” management level, dB $L_{Aeq, 15min}$	External Noise Level, dB $L_{Aeq, 15min}$
1, 3, 6, 7, 8, 9, 10, 11	Residential	Mon-Fri 0700-1800hrs	65	75	---
		Sat 0800-1300hrs	65	75	---
2	Commercial	Mon-Fri 0700-1800hrs	---	---	70
		Sat 0800-1300hrs	---	---	70
4	Place of Worship	Mon-Fri 0700-1800hrs	---	---	55 ¹
		Sat 0800-1300hrs	---	---	55 ¹
5	School (classroom)	Mon-Fri 0700-1800hrs	---	---	55 ¹
		Sat 0800-1300hrs	---	---	55 ¹
5	School (playing fields)	Mon-Fri 0700-1800hrs	---	---	60
		Sat 0800-1300hrs	---	---	60

¹ The external noise level applicable to these receivers has been derived by taking the internal noise level of 45 dB $L_{Aeq (15 min)}$ as stipulated in the ICNG and adding 10dB to account for the likely performance of the receiver facade

Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level.

Where the “noise affected” management level is predicted to be exceeded, the ICNG requires that all feasible and reasonable work practices are employed and that all potentially impacted receivers should be informed.

APPENDIX C CONSTRUCTION NOISE IMPACT ASSESSMENT

Noise levels during the demolition, excavation and construction phases have been calculated at the nominated occupancies during the demolition, excavation and general construction phases. These 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 practise for noise and vibration control on construction and open sites.

We have presented data below for “worst-case” situations where noise sources will either be closest to the noise sensitive receiver and/or not screened by existing site structures. Noise levels have also been presented for the “average” situation, with noise sources located towards the centre of the site. The latter is likely to be representative of the long term noise emissions.

For the purpose of our calculation, we have assumed that the following plant items will be working together simultaneously for between 25 to 100% of the time over a 15 minute period for the demolition, excavation and construction phases.

Table C 1: Equipment assumed to be operating simultaneously in a 15 minute period

Construction equipment	Demolition & site preparation	Piling & shoring	Construction – structure	Construction – finishes
12 tonne excavator	✓	✓		
22 tonne excavator	✓			
Jack hammer & breaker	✓	✓		
Concrete saw	✓	✓		
Concrete truck & pump		✓	✓	
Drop hammer piling rig		✓		
Tower crane			✓	✓
Core drill			✓	✓
Brick saw			✓	✓
Concrete vibrator			✓	
Concrete floats			✓	
Nail gun			✓	✓
Hydraulic bar cutter			✓	✓
Bogie truck	✓	✓	✓	
Flatbed truck				✓
Generator	✓	✓	✓	✓
Air compressor	✓	✓	✓	✓
Scissor lift				✓
Electric winch & materials hoist			✓	✓
De-watering plant (water pumps)		✓	✓	✓

C1 Demolition phase

Table C 2 details the predicted noise levels at the nominated occupancies during the demolition phase. Noise levels have been calculated at the property boundary that is most exposed to noise from demolition activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.1.

The calculated levels indicate that noise from demolition activities is below the “noise affected” goals for the “worst-case” assessment position at all residential receivers. Demolition activities may exceed the external noise limits by up to 9 dB at the nearest non-residential receivers when at their “worst-case” assessment position.

The average noise levels will likely be below the “noise affected” goals at all residential receivers and above the external noise limit by up to 5 dB at non-residential receivers. During the demolition phase, the use of the jack hammer, the concrete saw/ring saw and use of bogie trucks has the highest potential to impact on the noise received at the nominated occupancies.

C2 Piling and shoring phase

Table C 3 details the predicted noise levels at the nominated occupancies during the piling and shoring phase. Noise levels have been calculated at the property boundary that is most exposed to noise from piling and shoring activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.1.

The calculated levels indicate that noise from piling and shoring activities is up to 6 dB above the “noise affected” goals for the “worst-case” assessment position at residential receivers. Piling and shoring activities may exceed the external noise limits by up to 16 dB at the nearest non-residential receivers when at their “worst-case” assessment position.

The average noise levels will likely be up to 1dB above the “noise affected” goals at a single residential receiver and above the external noise limit by up to 12dB at non-residential receivers. During the piling and shoring phase, the use of the jack hammer, the drop hammer piling rig and use of bogie trucks has the highest potential to impact on the noise received at the nominated occupancies.

C3 Construction (Structure) phase

Table C 4 details the predicted noise levels at the nominated occupancies during the construction (structure) phase. Noise levels have been calculated at the property boundary that is most exposed to noise from demolition activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.1.

The calculated levels indicate that noise from construction (structure) activities is up to 7 dB above the “noise affected” goals for the “worst-case” assessment position at residential receivers. Construction (structure) activities may exceed the external noise limits by up to 17 dB at the nearest non-residential receivers when at their “worst-case” assessment position.

The average noise levels will likely be up to 2dB above the “noise affected” goals at residential receivers and above the external noise limit by up to 13dB at non-residential receivers. During the construction (structure) phase the use of the tower crane, concrete truck, bogie truck, concrete saw/ring saw and the electric winch has the highest potential to impact on the noise received at the nominated occupancies.

C4 Construction (Finishes) phase

Table C 5 details the predicted noise levels at the nominated occupancies during the construction (finishes) phase. Noise levels have been calculated at the property boundary that is most exposed to

noise from construction (finishes) activities. Calculated noise levels include the effects of the noise control recommendations detailed in Section 5.1.

The calculated levels indicate that noise from construction (finishes) activities is up to 2dB above the “noise affected” goals for the “worst-case” assessment position at residential receivers. Construction (finishes) activities may exceed the external noise limits by up to 12 dB at the nearest non-residential receivers when at their “worst-case” assessment position.

The average noise levels will likely be below the “noise affected” goals at all residential receivers and above the external noise limit by up to 8dB at non-residential receivers. During the construction (finishes) phase, the use of the tower crane, flatbed truck and hydraulic bar cutter has the highest potential to impact on the noise received at the nominated occupancies.

Table C 2: Predicted noise levels during demolition works

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq, 15min} ¹	“Noise affected”		“Highly noise affected”		External	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB	Noise Level, dB L _{Aeq, 15mins}	Exceedance, dB
1	Within guideline hours ²	Worst-case	61	65	--	75	--	N/A	N/A
		Average	57		--		--		
2	Within guideline hours ²	Worst-case	63	N/A	N/A	N/A	N/A	70	--
		Average	58						--
3	Within guideline hours ²	Worst-case	64	65	--	75	--	N/A	N/A
		Average	59		--		--		
4	Within guideline hours ²	Worst-case	62	N/A	N/A	N/A	N/A	55	7
		Average	57						2
5 (classroom)	Within guideline hours ²	Worst-case	64	N/A	N/A	N/A	N/A	55	9
		Average	60		--		--		5
5 (recreation)	Within guideline hours ²	Worst-case	63	N/A	N/A	N/A	N/A	60	3
		Average	59						--
6	Within guideline hours ²	Worst-case	64	65	--	75	--	N/A	N/A
		Average	59		--		--		
7	Within guideline hours ²	Worst-case	61	65	--	75	--	N/A	N/A
		Average	58		--		--		
8	Within guideline hours ²	Worst-case	63	65	--	75	--	N/A	N/A
		Average	58		--		--		

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq, 15min} ¹	“Noise affected”		“Highly noise affected”		External	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB	Noise Level, dB L _{Aeq, 15mins}	Exceedance, dB
9	Within guideline hours ²	Worst-case	63	65	--	75	--	N/A	N/A
		Average	58		--		--		
10	Within guideline hours ²	Worst-case	63	65	--	75	--	N/A	N/A
		Average	58		--		--		
11	Within guideline hours ²	Worst-case	61	65	--	75	--	N/A	N/A
		Average	57		--		--		

¹ 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 CNG. Noise levels at upper floors without shielding are likely to be higher.

² Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

³ Calculations included the recommended noise controls detailed in Section 5.1

Table C 3: Predicted noise levels during piling and shoring works

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq, 15min} ¹	“Noise affected”		“Highly noise affected”		External	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB	Noise Level, dB L _{Aeq, 15mins}	Exceedance, dB
1	Within guideline hours ²	Worst-case	67		2		--		
		Average	63	65	--	75	--	N/A	N/A
2	Within guideline hours ²	Worst-case	70						--
		Average	65	N/A	N/A	N/A	N/A	70	--
3	Within guideline hours ²	Worst-case	71		6		--		
		Average	65	65	--	75	--	N/A	N/A
4	Within guideline hours ²	Worst-case	69						14
		Average	64	N/A	N/A	N/A	N/A	55	9
5 (classroom)	Within guideline hours ²	Worst-case	71						16
		Average	67	N/A	N/A	N/A	N/A	55	12
5 (recreation)	Within guideline hours ²	Worst-case	69						9
		Average	66	N/A	N/A	N/A	N/A	60	6
6	Within guideline hours ²	Worst-case	71		6		--		
		Average	66	65	1	75	--	N/A	N/A
7	Within guideline hours ²	Worst-case	68		3		--		
		Average	65	65	--	75	--	N/A	N/A
8	Within guideline hours ²	Worst-case	69		4		--		
		Average	65	65	--	75	--	N/A	N/A

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq, 15min} ¹	“Noise affected”		“Highly noise affected”		External	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB	Noise Level, dB L _{Aeq, 15mins}	Exceedance, dB
9	Within guideline hours ²	Worst-case	69		4		--		
		Average	65	65	--	75	--	N/A	N/A
10	Within guideline hours ²	Worst-case	69		4		--		
		Average	65	65	--	75	--	N/A	N/A
11	Within guideline hours ²	Worst-case	68		3		--		
		Average	60	65	--	75	--	N/A	N/A

¹ 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 CNG. Noise levels at upper floors without shielding are likely to be higher.

² Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

³ Calculations included the recommended noise controls detailed in Section 5.1

Table C 4: Predicted noise levels during construction (structure) works

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq,15min} ¹	"Noise affected"		"Highly noise affected"		External	
				Management level, dB L _{Aeq,15min}	Exceedance, dB	Management level, dB L _{Aeq,15mins}	Exceedance, dB	Noise Level, dB L _{Aeq,15mins}	Exceedance, dB
1	Within guideline hours ²	Worst-case	68	65	3	75	--	N/A	N/A
		Average	64		--		--		
2	Within guideline hours ²	Worst-case	71	N/A	N/A	N/A	N/A	70	1
		Average	66						--
3	Within guideline hours ²	Worst-case	72	65	7	75	--	N/A	N/A
		Average	66		1		--		
4	Within guideline hours ²	Worst-case	70	N/A	N/A	N/A	N/A	55	15
		Average	65						10
5 (classroom)	Within guideline hours ²	Worst-case	72	N/A	N/A	N/A	N/A	55	17
		Average	68						13
5 (recreation)	Within guideline hours ²	Worst-case	70	N/A	N/A	N/A	N/A	60	10
		Average	67						7
6	Within guideline hours ²	Worst-case	72	65	7	75	--	N/A	N/A
		Average	67		2		--		
7	Within guideline hours ²	Worst-case	69	65	4	75	--	N/A	N/A
		Average	66		1		--		
8	Within guideline hours ²	Worst-case	70	65	5	75	--	N/A	N/A
		Average	66		1		--		

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq, 15min} ¹	“Noise affected”		“Highly noise affected”		External	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB	Noise Level, dB L _{Aeq, 15mins}	Exceedance, dB
9	Within guideline hours ²	Worst-case	70	65	5	75	--	N/A	N/A
		Average	66		1		--		
10	Within guideline hours ²	Worst-case	70	65	5	75	--	N/A	N/A
		Average	66		1		--		
11	Within guideline hours ²	Worst-case	69	65	4	75	--	N/A	N/A
		Average	65		--		--		

¹ 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 CNG. Noise levels at upper floors without shielding are likely to be higher.

² Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

³ Calculations included the recommended noise controls detailed in Section 5.1

Table C 5: Predicted noise levels during construction (finishes) works

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq,15min} ¹	"Noise affected"		"Highly noise affected"		External	
				Management level, dB L _{Aeq,15min}	Exceedance, dB	Management level, dB L _{Aeq,15mins}	Exceedance, dB	Noise Level, dB L _{Aeq,15mins}	Exceedance, dB
1	Within guideline hours ²	Worst-case	64	65	--	75	--	N/A	N/A
		Average	60		--		--		
2	Within guideline hours ²	Worst-case	66	N/A	N/A	N/A	N/A	70	--
		Average	61						--
3	Within guideline hours ²	Worst-case	67	65	2	75	--	N/A	N/A
		Average	62		--		--		
4	Within guideline hours ²	Worst-case	65	N/A	N/A	N/A	N/A	55	10
		Average	60						5
5 (classroom)	Within guideline hours ²	Worst-case	67	N/A	N/A	N/A	N/A	55	12
		Average	63						8
5 (recreation)	Within guideline hours ²	Worst-case	66	N/A	N/A	N/A	N/A	60	6
		Average	62						2
6	Within guideline hours ²	Worst-case	67	65	2	75	--	N/A	N/A
		Average	62		--		--		
7	Within guideline hours ²	Worst-case	64	65	--	75	--	N/A	N/A
		Average	61		--		--		
8	Within guideline hours ²	Worst-case	66	65	1	75	--	N/A	N/A
		Average	61		--		--		

Receiver	Period	Assessment	Calculated noise level ³ , dB L _{Aeq, 15min} ¹	“Noise affected”		“Highly noise affected”		External	
				Management level, dB L _{Aeq, 15min}	Exceedance, dB	Management level, dB L _{Aeq, 15mins}	Exceedance, dB	Noise Level, dB L _{Aeq, 15mins}	Exceedance, dB
9	Within guideline hours ²	Worst-case	66	65	1	75	--	N/A	N/A
		Average	61		--		--		
10	Within guideline hours ²	Worst-case	66	65	1	75	--	N/A	N/A
		Average	61		--		--		
11	Within guideline hours ²	Worst-case	64	65	--	75	--	N/A	N/A
		Average	60		--		--		

¹ 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 CNG. Noise levels at upper floors without shielding are likely to be higher.

² Monday – Friday: 0700-1700hrs, Saturday 0800-1300hrs

³ Calculations included the recommended noise controls detailed in Section 5.1

APPENDIX D CONSTRUCTION NOISE SOURCES

A variety of demolition, piling and construction equipment will be used for this project. Table D 1 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 sites*
- BS5228-1-2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

Table D 1: Construction noise source sound power levels , dB L_{Aeq}

Noise source	A-weighted sound power level, L _{Aeq} dBW	Source
12 tonne excavator	98	BS5228-1-2009
22 tonne excavator	99	AS2436-2010
Jack hammer & breaker	121	AS2436-2010
Concrete saw	117	BS5228-1-2009
Concrete truck & pump	108	AS2436-2010
Drop hammer piling rig	119	BS5228-1-2009
Tower crane	105	AS2436-2010
Core drill	113	BS5228-1-2009
Brick saw	107	BS5228-1-2009
Concrete vibrator	103	AS2436-2010
Concrete floats	100	BS5228-1-2009
Nail gun	101	BS5228-1-2009
Hydraulic bar cutter	107	BS5228-1-2009
Bogie truck	107	AS2436-2010
Flatbed truck	107	AS2436-2010
Generator	99	AS2436-2010
Air compressor	101	AS2436-2010
Scissor lift	106	BS5228-1-2009
Electric winch & materials hoist	96	BS5228-1-2009
De-watering plant (water pumps)	99	BS5228-1-2009