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TARONGA ZOO UPPER AUSTRALIA PRECINCT EARLY WORKS PHASE 2 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT AND MANAGEMENT PLAN Rp 001 20210815 | 18 August 2021



Marshall Day Acoustics Pty Ltd ABN: 53 470 077 191 4/46 Balfour St Chippendale NSW 2008 Australia T: +612 9282 9422 www.marshallday.com

Project: TARONGA ZOO UPPER AUSTRALIA PRECINCT EARLY WORKS PHASE 2

- Prepared for: Lloyd Group Pty Ltd 14 Harvey Street Pyrmont NSW 2009
- Attention: Joseph Elley
- Report No.: **Rp 001 20210815**

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EXECUTIVE SUMMARY

Marshall Day Acoustics (MDA) has been engaged by Lloyd Group Pty Ltd (Lloyd Group) to undertake a noise and vibration assessment for construction works related to the Upper Australia Precinct exhibit at Taronga Zoo, Mosman, NSW

The assessment, and associated Construction Noise and Vibration Management Plan, have been developed considering Consent Condition B32 of the *Minister for Planning and Public Spaces Development Consent SSD 10456*.

Based on the requirements of SSD 10456, the following documentation has been considered:

- Environment Protection Authority's (EPA) Interim Construction Noise Guideline (ICNG)
- Environment Protection Authority's (EPA) Assessing Vibration: A Technical Guideline (AVTG)
- AS 2436-2010 Guide to noise control on construction, maintenance and demolition sites

Detailed information regarding construction phases and equipment items has been provided by Lloyd Group, from which construction noise levels have been calculated at the nearest residential receivers.

Generally, noise emissions are well controlled due to the distances to the receivers, limited concurrent equipment activity and screening offered by the topography and infrastructure between the work site and the residential receivers.

For the highest noise generating activity, diamond core drilling, mobile noise barriers should be implemented. With this noise control in place noise emissions from all proposed phases are capable of complying with the Noise Affected management levels derived in accordance with the ICNG. Vibration emissions are expected to be entirely controlled by the significant distance to sensitive receivers.

A Construction Noise and Vibration Management Plan has also been developed to enable Lloyd Group to operate with best practises.

A summary of compliance with Consent Condition B32 is provided in Table 1.

Clause	Evidence
a)	Description of reference documents - Section 1.0 Derivation of ICNG management levels - Section 5.0 and APPENDIX C
b)	Site description - Section 3.0
c)	Derivation of ICNG management levels - Section 5.0 and APPENDIX C
d)	Description of proposed works – Section 3.0 Derivation of associated noise levels - APPENDIX D
e)	Noise control recommendations – Section 6.2
f)	Description of reference documents - Section 1.0 Description of prediction procedure - APPENDIX E
g)	The conceptual, planning stage construction noise and vibration assessment and CNVMP detailed in Rp 002 20200446 - Taronga Zoo - Upper Australia Exhibit SSDA Acoustic Assessment, dated 15 June 2020, is superseded by this updated document which reflects specific proposed works, methodology, and equipment.
h)	Letter drop comments – Section 7.1 and APPENDIX F

Table 1: SSD 10456 Consent Condition B32 - Summary table



Clause	Evidence
i)	Noise and vibration monitoring not necessary due to low likelihood of adverse
	impact and general alignment with ICNG management levels – Section 7.0

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1.0 INTRODUCTION

Taronga Zoo are developing a new "Upper Australia" exhibit at their existing premises in Mosman, providing a representation of Australia's flora and fauna in a natural habitat.

Lloyd Group Pty Ltd (Lloyd Group) have been appointed as the main contractor for the works and have requested that Marshall Day Acoustics (MDA) assess construction noise and vibration and provide a Construction Noise and Vibration Management Plan (CNVMP) for the project.

A previous conceptual assessment and CNVMP was conducted at planning stage and was submitted as part of a State Significant Development Application (SSDA). The planning stage CNVMP was summarised in Rp 002 20200446 - *Taronga Zoo - Upper Australia Exhibit SSDA Acoustic Assessment*, (SSDA Assessment) dated 15 June 2020. Whilst the SSDA CNVMP forms the basis of this updated assessment, the findings and recommendations of this assessment supersede that of the SSDA document.

This construction stage acoustic and vibration assessment considers the following documentation:

- Minister for Planning and Public Spaces Development Consent SSD 10456: Condition B32
- Environment Protection Authority's (EPA) Interim Construction Noise Guideline (ICNG)
- Environment Protection Authority's (EPA) Assessing Vibration: A Technical Guideline (AVTG)
- AS 2436-2010 Guide to noise control on construction, maintenance and demolition sites

The assessment is based on construction staging and proposed equipment items as provided by Lloyd Group.

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

2.0 PROJECT DESCRIPTION

The exhibit will comprise a path through various landscapes, tree canopies and koala habitats, rock escarpments and through to the nocturnal house. It is understood the project will include the following key elements:

- complete refurbishment of the existing nocturnal house;
- construction of a new koala encounter and canopy walk;
- new / extended macropod walkthrough;
- creation of a new eastern plaza and western pavilion;
- upgrades to back of house facilities for animal care;
- new toilets and amenities for staff and visitors;
- other supporting infrastructure and walkways; and
- modifications to the existing ropes course including a new entrance.

3.0 SITE DESCRIPTION AND PROPOSED WORKS

The proposed Upper Australia Exhibit is located at Taronga Zoo, Bradleys Head Road, Mosman, NSW, and is bounded by the Taronga Zoo site on the north, south and west and by Bradleys Head Road on the east.

Residential premises are located along Bradleys Head Road and Whiting Beach Road, with the nearest residence approximately 200 m from the site. A site map showing the location of the Upper Australia Exhibit site and nearby receivers is provided in Figure 1. Only receivers outside the Taronga Zoo grounds have been considered.



The nearest noise sensitive receivers have been selected to be representative for the purpose of our assessments and calculations and are detailed in Table 2. The land use for each receiver has been described in accordance with the sensitive land uses detailed in the ICNG.

This assessment considers construction noise in terms of Worst-Case and Average scenarios with Average typically relating to a plant position to the centre of the site and Worst-Case at a position within the site closest to the receiver. Distances correlating with these scenarios are detailed in Table 2.

Receiver	Location	Land Use	Distance to development, m	
			Average	Worst Case
1	1 Bradleys Head Road	Residential	230	180
2	2 Whiting Beach Road	Residential	240	190

Table 2: Nearby noise sensitive receivers and land uses





Lloyd Group have advised that construction activities on-site will only occur during the recommended standard hours for construction work on-site, as described in the ICNG:

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



Construction phases and equipment items have been defined by Llyod Group and are summarised in Table 3. A detailed breakdown of phases and proposed activities is provided in Appendix B.

Phase	Equipment
Demolition/Civil Works	13.5 T excavator
	5.5 T excavator
	Inc. attachments - mulcher, grab, hammer and buckets
Excavation and Disposal	13.5 T excavator with mulcher, grab or bucket
	Bogie truck
	Hose (dust suppression)
Construction - Structure	Concrete pump
	Concrete vibrator
	Concrete floats
	Diamon core drill
	Nail guns
	Concrete truck
	Bogie truck
	Delivery truck
	Generator
	Air compressor & lines
	De-watering plant
	Pressure cleaner

Table 3: Prop	osed const	ruction phas	ses and ed	nuipment
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4.0 BACKGROUND NOISE LEVELS

Background noise levels at the site have previously been measured between 20 May 2020 and 2 June 2020 as part of the SSDA Assessment, using an unattended noise logger.

Calibration of the equipment was performed before and after the deployment with no significant drifts were observed. The noise logger data was processed according to the NSW EPA's Noise Policy for Industry (NPfI) to eliminate extraneous noise from adverse weather conditions.

Due to the zoo's location close to the harbour foreshore, the measurement position is subject to extended periods of wind speeds above 5 m/s, with elevated wind speeds being observed as an inherent feature of the site. In line with guidance for weather affected sites provided in the NPfI, the exclusion limit for wind speed was raised from 5 m/s to 6 m/s.

Background noise results for the survey are presented in Table 4.

Time	Background noise level, dB LA90 15 mins	Ambient noise level, dB LAeq 15 mins
Day: 0700-1800 hrs	43	55
Evening: 1800-2200 hrs	41	48
Night: 2200-0700 hrs	40	46

Table 4: Measured background noise level



We note that due to COVID-19 restrictions in place at the time of the noise survey, measured noise levels are likely to be lower than typical noise levels without COVID restriction in place. This is primarily due to reduced vehicle movements and closure of the zoo.

5.0 CONSTRUCTION NOISE & VIBRATION CRITERIA

Consent Condition B32 of the Minister for Planning and Public Spaces Development Consent SSD 10456 outlines the requirements for the assessment of construction noise and vibration and the preparation of a CNVMP for the project.

The condition references the ICNG for the assessment of construction noise which in turn references the *AVTG* for the assessment of construction vibration.

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

B32. Prior to the commencement of works, a Construction Noise and Vibration Management Plan (CNVMP) must be prepared by a suitably qualified person. The CNVMP shall address (but not be limited to):

(a) be prepared in accordance with the EPA's Interim Construction Noise Guideline;

(b) identify nearby sensitive receivers and land uses;

(c) identify the noise management levels for the project;

(d) identify the construction methodology and equipment to be used and the key sources of noise and vibration;

(e) include details of all reasonable and feasible management and mitigation measures to be implemented to minimise construction noise and vibration;

(f) address the relevant provisions of Australian Standard 2436-2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites;

(g) be consistent with and incorporate all relevant recommendations and noise and vibration mitigation measures outlined in the Taronga Zoo – Upper Australia Exhibit SSDA Acoustic Assessment prepared by Marshall Day Acoustics, dated 15 June 2020;

(h) ensure all potentially impacted sensitive receivers are informed by letterbox drops prior to the commencement of construction of the nature of works to be carried out, the expected noise levels and duration, as well as contact details for a construction community liaison officer;

(i) include a suitable proactive construction noise and vibration monitoring program which aims to ensure the construction noise and vibration criteria in this consent are not exceeded;

Prior to the commencement of works, details demonstrating compliance with the above requirements (Condition

32(a)-(i)) must be submitted to the Certifier. A copy of the CNVMP must be submitted to the Certifier, Council and the Planning Secretary.

5.1 Construction noise criteria

Construction noise criteria have been derived based on the average background levels presented in Table 4. A full derivation of the criteria is set out in Appendix C, with a summary provided in Table 5. Only the day-time period is considered as no construction work is proposed outside of this period.



Receiver	Location	Туре	Management Level, dB LAeq 15 min	
			Noise Affected	Highly Noise Affected
1	1 Bradleys Head Road	Residential	53	75
2	2 Whiting Beach Road	Residential	53	75

Table 5: Construction noise management levels

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.

5.2 Construction vibration criteria

The ICNG refers assessment of construction vibration to the EPA document *Assessing Vibration: A Technical Guideline* (AVTG).

Whilst the AVTG provides guidelines for the assessment of vibration impacts on people, no direct instruction or guidance is provided for the assessment of impacts on structures. For assessment of vibration effects on structures the German standard DIN4150-3 *Structural vibration – Effects of vibration on structures -1999* is generally accepted in industry and is used for the purposes of this assessment.

5.2.1 Vibration limits – Effects on people

The AVTG provides a vibration dose value (VDV) criterion 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 6 below.

Table 6: Acceptable vibration dose values for intermittent vibration

	Day-time ¹	
Receiver type	Preferred value	Maximum value
Residences	0.20	0.40
Offices	0.40	0.80
	0110	3.00

¹ 16 hour day period 0600-2200 hrs.

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

5.2.2 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 7.



Line	Type of structure	Vibration at the foundation of building, at a frequency of			Vibration in horizontal plane
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz and above	of highest floor, at all frequencies
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

Table 7: Vibration limits according to DIN 4150: Peak Particle Velocity (PPV) mm/s

Experience has shown that if the guideline values of Table 7 are complied with, damage which reduces the serviceability of the building will not occur. The criterion of 5 mm/s PPV for dwellings is considered appropriate for this assessment.

6.0 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

An assessment of construction noise and vibration has been conducted considering the construction stages and equipment items proposed by Lloyd Group, summarised in Table 3 and detailed in Appendix B.

Noise levels associated with the proposed equipment items are presented in Appendix D and have been sourced from technical references including:

- AS 2436-2010: Guide to noise and vibration control on construction, demolition and maintenance sites
- BS 5228-1-2009: Code of practice for noise and vibration control on construction and open sites Part 1: Noise

A full detailed noise assessment is provided in Appendix E. A summary of the results is presented in the following sections alongside noise control recommendations and mitigation solutions for implementation on-site.

Predicted noise calculations include a 5 dB reduction for the screening offered by the topography and infrastructure between the work site and the residential receivers.

6.1 Assessment summary

6.1.1 Demolition/Civil Works phase

The calculated levels indicate that noise from Demolition/Civil Works will be well controlled due to the distances to the receivers, limited concurrent equipment activity and screening offered by the topography and infrastructure between the work site and the residential receivers.

Predicted noise levels are 8 dB and 14 dB below the Noise Affected management level for Worst-case and Average scenarios respectively.



The ICNG indicates that noise below the Noise Affected management level is less likely to give rise to community reaction to noise. Additionally, consideration of the measured ambient noise levels, as detailed in Section 4.0, indicates that levels of 55 dB $L_{Aeq 15 mins}$ are typical during the daytime. Given this, noise from construction activities during the Demolition/Civil Works are unlikely to be emergent above the ambient noise level at the residential receivers.

The ICNG indicates that noise control or mitigation measures are required where the Noise Affected management level is exceeded. As works are not indicated to exceed the Noise Affected management level, additional noise control or mitigation measures are not necessary.

6.1.2 Excavation and Disposal phase

Similar to the Demolition/Civil Works phase, calculated levels indicate that noise from Excavation and Disposal works are predicted to be 7 dB and 10 dB below the Noise Affected management level for Worst-case and Average scenarios respectively. Noise from Excavation and Disposal works is subject to the same useful environmental screening between the proposed sources and residential receivers and the proposed construction plan mean a small number of equipment items are in operation concurrently.

As such, conclusions related to the Excavation and Disposal works are broadly similar to that for the Demolition/Civil works, with predicted noise levels indicating lower likelihoods of community reaction to noise and lower likelihoods of emergence above typical ambient noise levels. Noise from the proposed works are not indicated to exceed the Noise Affected management level and additional noise control or mitigation measures are not necessary.

6.1.3 Construction - Structures phase

Generally, noise from equipment associated with the Construction – Structures phase is well controlled by the distance and screening between the sources and residential receivers. Diamond core drilling has higher associated noise levels than all other equipment items during this phase. In order to appropriately control noise emissions during use, additional noise controls are recommended for this activity. Noise control recommendations are outlined in Section 6.2.

With the implementation of the noise control recommendations, calculated levels indicate that noise from Construction – Structures works are predicted to be 1 dB and 7 dB below the Noise Affected management level for Worst-case and Average scenarios respectively.

On this basis noise impacts from Construction – Structures are deemed to be effectively reduced and represent a lower likelihood of community reaction to noise, based on guidance provided in the ICNG.

6.2 Noise control recommendations

Noise from Demolition/Civil Works and Excavation and Disposal phases have been demonstrated to be unlikely to give rise to exceedance of the Noise Affected management levels, and consequently, represent a low likelihood of adverse noise impacts. Specific noise control recommendations for these phases are not necessary.

Due to the high noise levels associated with diamond core drilling, limited noise control measures are recommended for the Construction – Structures phase. Details are provided in Table 8.

MDA's calculations include the effects of these recommendations. Where these recommendations are not implemented, noise management levels may be exceeded and adverse noise impacts may become more likely.



Table 8: Noise control recommendations for site

Phase	Equipment	Recommendation
Construction - Finishes	Diamond core drill	 Localised noise barriers should be utilised when this equipment is used.
		 Barriers should be mobile and extend to a height 1 m above the drilling noise source.
		 Any barrier should envelope the work location
		- Practical and feasible measures should be taken to allow the noise barrier to be located within 4 m of the noise source.

6.3 Vibration

Generally, the equipment items proposed by Lloyd Group for construction activities are not significant sources of vibration. 13 T and 5.5 T excavators represent some of the smallest excavator types in typical use on construction sites.

For these equipment items, typical exclusion distances aligning with the structural and human exposure impact criteria detailed in Section 5.2 are in the order of 1-10 m, dependent on ground type, foundations/footings of nearby receivers and type of operation of the excavator (excavation, breaking, shovelling etc.).

The distances to nearby residential receivers range from 180 m to 240 m. In all instances it is expected that such distances will be more than adequate to mitigate vibration transmission from each phase of work with a very low likelihood of adverse vibration impacts.

7.0 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

In many instances a Construction Noise and Vibration Management Plan is enacted to ensure that noise and vibration impacts are minimised in practise. Generally, noise and vibration emissions from the proposed construction works are likely to be inherently well controlled by the topography and infrastructure between the work site and residential receivers, and do not represent a significant risk of adverse impact

Regardless of the likelihood of impact, it is appropriate for a responsible main contractor to establish protocols and procedures that adopt best practises when construction noise and vibration is considered. A Construction Noise and Vibration Management Plan detailing these best practises is detailed in the following sections.

If adverse noise or vibration impacts were likely a campaign of noise and vibration monitoring might be implemented. Due to low risk level associated with the works proposed by Lloyd Group, as assessed in this report, noise and vibration monitoring is not considered necessary.

7.1 Community consultation and negotiation

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

- All nearby noise sensitive receivers should be informed, reasonably ahead of time, of the nature of works to be carried out, the expected noise levels from noisier activities and their duration, and the measures being taken to minimise noise from the construction
- Effective channels of communication must be established between the contractor/developer, Local Authority and affected receivers.



• A site representative responsible for all matters relating to noise should be appointed and contact details of this representative 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.

Lloyd Group have advised that a letter drop to residents has been conducted providing details of the proposed works. A copy of the letter issued to residents is shown in Appendix F. We note that due to the date of the letter drop, information provided in the letter does not reflect the latest information detailed in this report.

7.2 Scheduling of activities and providing respite periods

Generally, proposed works are unlikely to give rise to periods of particularly high noise levels at receivers and have been demonstrated to comply with the ICNG management levels, with the implementation of the diamond core drilling specific noise controls. On this basis specific scheduling of works are not required as a matter of course.

In the event that a noise complaint is registered, where further control of noise levels will be required. One method of limiting noise impact is through scheduling of works. Guidance for such scheduling, should it be required, is provided below:

- All site work is currently proposed to be conducted during the ICNG recommended standard hours. This must also apply to site deliveries.
- Schedule high noise activities to be undertaken when background noise, including local road traffic, is high to provide masking to construction noise.
- Scheduling of high noise works, where practical and feasible, such as diamond core drilling, to concentrate these activities during the weekday periods and avoid weekends, will assist in minimising emissions when higher levels of noise sensitivity may occur
- Where noise complaints occur, ensure that periods of respite are provided when noisier activities such as diamond core drilling take place. Respite periods may be provided by restricting the hours in which the noisiest activities can take place.

7.3 Management work practices

- Plan deliveries and access to the site to occur quietly and efficiently and within standard construction hours. 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 not occur.
- 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 when close to residences.

7.4 Construction noise control measures

Predicted noise levels detailed in this report consider the mobile noise barrier for diamond core drilling detailed in Section 6.2.

In addition to this specific noise control measure it is envisaged that a variety of additional practicable noise control measures may be employed to further reduce noise emissions (where feasible)

- Using existing structures and temporary site structures and material stockpiles as noise barriers
- Where feasible, reducing the line-of sight from noise source to receiver through erection of barriers around static items producing continuous noise e.g. compressors and generators



- 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

7.5 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	Sound Power Level 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.
dB	<u>Decibel</u> The unit of sound level.
	Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μ Pa i.e. dB = 20 x log(P/Pr)
dBA	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.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
L _{Aeq} (t)	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.
L _{A90}	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
Vibration	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).
PPV	Peak Particle Velocity For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
VDV	Vibration Dose Value Vibration Dose Value is based on British Standard BS 6472:1992 Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) 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.



Phase	Activities	Equipment
Demolition/Civil Works	Site Establishment/mobilisation	13.5 T excavator
		5.5 T excavator
		Inc. attachments - mulcher, grab, hammer and buckets
	Exclusion zone setup	Temporary Fencing
	Mulch RCC structures	13.5 T excavator
	Demolish footings	13.5 T excavator with hammer
Excavation and Disposal	Mulch RCC structures	13.5 T excavator with mulcher
	Disposal of concrete	Bogie truck
	Loading (large pieces)	13.5 T excavator with grab
	Loading (small pieces)	13.5 T excavator with bucket
	Dust control	Hose and labour
Construction - Structure	Concreting/Drilling Dowels	Concrete pump
		Concrete Vibrator
		Concrete Floats
		Diamon core drill
		Nail guns
	Delivery of materials	Concrete truck
		Bogie truck
		Steel Delivery Truck
	General	Generator
		Air compressor & lines
		De-watering plant
		Pressure cleaner

APPENDIX B CONSTRUCTION PHASES, ACTIVITIES AND EQUIPMENT

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APPENDIX C CONSTRUCTION NOISE CRITERIA

The NSW EPA Interim Construction Noise Guideline (ICNG) provides guidance for assessing noise associated with construction activities and sets out management levels above which there may be community reaction to construction noise.

Management levels are described as:

- Noise Affected level which is a level "above which there may be some community reaction to noise"
- Highly Noise Affected level which is a level "above which there may be a strong community reaction to noise"

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

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

Based on the above, the Noise Affected management level is derived by considering the background noise level (referred to in the ICNG as the rating background level, RBL) and hours at which construction works occur; adding 10 dB for work during the recommended hours or adding 5 dB outside these recommended hours.

The Highly Noise Affected level for residential receivers is set independent of the RBL, as 75 dB $L_{Aeq,\,15\,mins}$.

Background noise levels at the site have previously been measured between 20 May 2020 and 02 June 2020 as part of the SSDA Assessment. The measured average background sound pressure levels are presented in Table C 1.

Location	Background noise level LA90 (period) dB				
	Daytime (0700 -1800 hrs)	Evening (1800 – 2200 hrs)	Night (2200 – 0700 hrs)		
Within work site	43	41	40		

The construction noise management levels for the subject residential receivers are summarised in Table C 2 and apply throughout the recommended standard construction hours noted above.

Receiver	Location	Туре	Management Level, dB LAeq 15 min	
			Noise Affected	Highly Noise Affected
1	1 Bradleys Head Road	Residential	53	75
2	2 Whiting Beach Road	Residential	53	75

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

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APPENDIX D CONSTRUCTION NOISE SOURCES

Table D 1 provides a schedule of construction equipment that Lloyd Group propose to use on this site including references for the associated noise levels used for assessment, as sourced from the following standards:

- AS 2436-2010: Guide to noise and vibration control on construction, demolition and maintenance sites
- BS 5228-1-2009: Code of practice for noise and vibration control on construction and open sites Part 1: Noise

Noise source	A-weighted sound power level, $L_{Aeq}dBW$	Source
13.5 T excavator with mulcher	102	BS 5228-1
13.5 T excavator with grab	102	BS 5228-1
13.5 T excavator with bucket	100	BS 5228-1
13.5 T excavator with hammer	104	BS 5228-1
5.5 T excavator with mulcher	99	BS 5228-1
Bogie truck	103	AS 2436
Hose (dust suppression)	n/a*	n/a
Concrete pump	103	BS 5228-1
Concrete vibrator	97	BS 5228-1
Concrete floats	100	BS 5228-1
Diamond core drill	118	BS 5228-1
Nail guns	101	BS 5228-1
Concrete truck	103	AS 2436
Bogie truck	103	AS 2436
Delivery truck	103	AS 2436
Generator	99	AS 2436
Air compressor & lines	101	AS 2436
De-watering plant	99	BS 5228-1
Pressure Cleaner	100	BS 5228-1

Table D 1: Construction noise source sound power levels, dB LAeq

* Not considered to be a significant noise source



APPENDIX E CONSTRUCTION NOISE IMPACT ASSESSMENT

Noise levels during the proposed work stages have been calculated at the nominated residential receivers under guidance from AS 2436-2010 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.

For the purpose of our calculations, assumptions have been made with respect to the equipment items that will be working together simultaneously, based on the proposed staging and activities detailed in Appendix B. "On" time durations are defined between 0 to 100% of the time over a 15 minute period.

Data is presented in terms of both the Worst-case scenario; where noise sources will either be closest to the noise sensitive receiver and/or not screened by existing site structures, and Average scenario; where noise sources are located towards the centre of the site.

In addition the Worst-case scenario reflects equipment in concurrent use during the most intensive work activities within the proposed phase. The Average scenario features typical equipment activity throughout the majority of the proposed phase.

Generally, Worst-case activities will occur at limited times and for shorter durations than the activities associated with the Average scenario, with the latter more likely to be representative of the long term noise emissions over the subject phase.

Equipment	Prediction scenario "On" duration, %		
	Worst-case	Average	
13.5 T excavator with mulcher		50	
13.5 T excavator with grab			
13.5 T excavator with bucket			
13.5 T excavator with hammer	100		
5.5 T excavator with mulcher		50	

Table E 1: Demolition/Civil Works - Equipment operation assumptions, 15 minute period

Table E 2: Excavation and Disposal - Equipment operation assumptions, 15 minute period

Equipment	Prediction scenario "On" duration, %		
	Worst-case	Average	
13.5 T excavator with mulcher			
13.5 T excavator with grab	100		
13.5 T excavator with bucket		100	
Bogie truck	100	100	



Equipment	Prediction scenario "On" duration, 9		
	Worst-case	Average	
Concrete pump	100	50	
Concrete vibrator	100	50	
Concrete floats	100	50	
Diamond core drill	25		
Nail guns		25	
Concrete truck	25	25	
Bogie truck			
Delivery truck			
Generator	100	100	
Air compressor & lines	100	100	
De-watering plant	100	100	
Pressure cleaner	50	25	

Table E 3: Construction - Structures - Equipment operation assumptions, 15 minute period

E1 Demolition/Civil Works phase

Table E 4 details the predicted noise levels at the nominated residences during the Demolition/Civil Works phase.

The calculated levels indicate that noise from Demolition/Civil Works will be well controlled due to the distances to the receivers, limited concurrent equipment activity and screening offered by the topography and infrastructure between the work site and the residential receivers

Predicted noise levels are 8 dB and 14 dB below the Noise Affected management level for Worst-case and Average scenarios respectively.

The ICNG indicates that noise below the Noise Affected management level is less likely to give rise to community reaction to noise. Additionally, consideration of the measured ambient noise levels, as detailed in Section 4.0, indicates that levels in the order of 55 dB L_{Aeq 15 mins} are typical during the daytime. Given this, noise from construction activities during the Demolition/Civil Works is unlikely to be emergent above the ambient noise level at the residential receivers.

The ICNG indicates that noise control or mitigation measures are required where the Noise Affected management level is exceeded. As works are not indicated to exceed the Noise Affected management level, additional noise control or mitigation measures are not necessary.

E2 Excavation and Disposal phase

Table E 5 details the predicted noise levels at the nominated residences during the Excavation and Disposal phase.

Similar to the Demolition/Civil Works phase, calculated levels indicate that noise from Excavation and Disposal works are predicted to be 7 dB and 10 dB below the Noise Affected management level for Worst-case and Average scenarios respectively. Noise from Excavation and Disposal works is subject to the same useful environmental screening between the proposed sources and residential receivers and the proposed construction plan means a limited number of equipment items are in operation concurrently.



As such, conclusions related to the Excavation and Disposal works are broadly similar to that for the Demolition/Civil works, with predicted noise levels indicating lower likelihoods of community reaction to noise and lower likelihoods of emergence above typical ambient noise levels. Noise from the proposed works are not indicated to exceed the Noise Affected management level and additional noise control or mitigation measures are not necessary.

E3 Construction - Structures phase

Table E 6 details the predicted noise levels at the nominated residences during the Construction – Structures phase.

Generally, noise from equipment associated with the Construction – Structures phase is well controlled by the distance and screening between the sources and residential receiver. Diamond core drilling has higher associated noise levels than all other equipment items during this phase. In order to appropriately control noise emissions during use, additional noise controls are recommended for this activity. Noise control recommendations are outlined in Section 6.2.

With the implementation of the noise control recommendations, calculated levels indicate that noise from Construction – Structures works are predicted to be 1 dB and 7 dB below the Noise Affected management level for Worst-case and Average scenarios respectively.

On this basis noise impacts from Construction – Structures are deemed to be effectively reduced and represent a lower likelihood of community reaction to noise, based on guidance provided in the ICNG.



Table E 4: Predicted noise levels during Demolition/Civil works

Receiver	Period	Assessment	Calculated noise level ² , dB L _{Aeq, 15min} ³	Noise Affected, dB LAeq,15mins		Highly Noise Affected, dB LAeq,15mins	
				Management level	Exceedance	Management level	Exceedance
1	Within guideline hours ¹	Worst-Case	45	53		75	
		Average	39			75	
2	Within guideline hours ¹	Worst-Case	43	52		75	
		Average	39	53		75	

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

² Calculations included the recommended noise controls detailed in Section 6.2 (where applicable)

³ Unless noted otherwise, the noise level is calculated at 1.5 m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.

Table E 5: Predicted noise levels during Excavation and Disposal works

Receiver	Period	d Assessment		Noise Affected, dB LAeq,15mins		Highly Noise Affected, dB LAeq,15mins	
			level ² , dB L _{Aeq} , 15min ³	Management level	Exceedance	Management level	Exceedance
1	Within guideline hours ¹	Worst-Case	46	50		75	
		Average	43	53		75	
2	Within guideline hours ¹	Worst-Case	45	52		75	
		Average	43	53		/5	

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

² Calculations included the recommended noise controls detailed in Section 6.2 (where applicable)

³ Unless noted otherwise, the noise level is calculated at 1.5 m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.



Table E 6: Predicted noise levels during Construction - Structures works

Receiver	Period	Assessment	Calculated noise level ² , dB L _{Aeq, 15min} ³	Noise Affected, dB LAeq, 15mins		Highly Noise Affected, dB LAeq,15mins	
				Management level	Exceedance	Management level	Exceedance
1	Within guideline hours ¹	Worst-Case	52	53		75	
		Average	46				
2	Within guideline hours ¹	Worst-Case	50	53		75	
		Average	45			75	

¹ Monday – Friday: 0700-1700 hrs, Saturday 0800-1300 hrs ² Calculations included the recommended noise controls detailed in Section 6.2 (where applicable)

³ Unless noted otherwise, the noise level is calculated at 1.5 m above ground level at the property boundary most exposed to construction noise in accordance with the requirements of the ICNG. Noise levels at upper floors without shielding are likely to be higher.



APPENDIX F LLOYD GROUP LETTER DROP DOCUMENT

2nd August 2021

Dear Resident

We are writing to inform you that Lloyd Group have been appointed as Head Contractor for the Upper Australia Early Works project that will be commencing work on site at Taronga Zoo in Early August 2021. We are proud to have been selected for this project and look forward to contributing to this significant community project.

The works include the demolition and civil works for the Upper Australia Precinct at the Taronga Zoo. Whilst we will be working to minimise impacts to the local neighbourhood as a local resident from time to time there may be some disruption to traffic and noise around the site.

There are Development Consent Conditions and Government guidelines for how Lloyd Group must operate on site at Taronga. These can be found at https://www.planningportal.nsw.gov.au/maior-projects/project/32596. As part of these works, we as the Head Contractor will work to minimise the impacts and disruption to you during construction.

For the duration of the works, we will continue to monitor and control the noise levels by using noise barriers for static equipment to monitor and control noise. We will be providing shade cloth to the perimeter of the site and conducting works within the approved construction hours described above to mitigate disruption to the local community. We have developed a traffic management plan which will strictly control the movement of trucks to minimise the impact on the local community.

Based on the acoustic report by Marshall Day Acoustics, entitled Upper Australia Habitat - SSDA Acoustic

Assessment dated 15/06/2020 the applicable construction noise criteria are:

- LAeq,15 min (daytime) ≤ 43 dB, for residential premises near Site Location 1 and

- LAeq,15 min (daytime) < 55 dB, for residential premises near Site Location 2

As per NSW Government Regulations for Covid-19, Lloyd Group will ensure that the strict guidelines are adhered to at all times inside and around our site for the safety of our workers and general public. Contractors from the Locked down LGAs will not be attending site, daily updates will be provided to Taronga showcasing who will be coming to site the following day including the LGA they live in and where they have travelled to in the past 7 days. Social distancing will be adhered to on site and all contractors are to wear masks while working. There will also be a Service NSW QR code that will be signed into daily. Amendments and updates will continue as new information/updates in health advice come from NSW Health.

I invite you as a local resident to provide feedback to Lloyd Group to ensure we engage and fulfill our responsibilities while working in your local area.

This can be done by contacting myself Joseph Elley, Lloyds Project Manager.

Regards,

JOSEPH ELLEY PROJECT MANAGER A: 14 Harvey Street, Pyrmont, Sydney, NSW 2009 P: (02) 8565 6777 E: Joseph.Elley@lloydgroup.com.au