NOISE IMPACT ASSESSMENT
FOR GOODMAN PROPERTY SERVICES
224-398 BURLEY ROAD, HORSLEY PARK

Prepared for: Guy Smith, Planning Manager, Goodman Property Services

---

Prepared by: Victoria Hale, Environmental Scientist
Peter Gangemi, Senior Acoustic Engineer
R T Benbow, Principal Consultant

Report No: 181156_NIA_Rev4
March 2019
(Released: 11 March 2019)

Benbow ENVIRONMENTAL

Engineering a Sustainable Future for Our Environment

Head Office: 25-27 Sherwood Street, Northmead NSW 2152 AUSTRALIA
Tel: 61 2 9896 0399 Fax: 61 2 9896 0544
Email: admin@benbowenviro.com.au
Visit our website: www.benbowenviro.com.au

DOCUMENT CONTROL

Prepared by:	Position:	Signature:	Date:
Victoria Hale	Environmental Scientist		11 March 2019
Peter Gangemi	Senior Acoustic Engineer		

Reviewed by:	Position:	Signature:	Date:
Emma Hansma	Senior Engineer		11 March 2019

Approved by:	Position:	Signature:	Date:
R T Benbow	Principal Consultant		11 March 2019

DOCUMENT REVISION RECORD

Revision	Date	Description	Checked	Approved
1	4-12-2018	Rev1 / Draft	E Hansma	R T Benbow
2	18-2-2019	Rev2 / Draft	E Hansma	R T Benbow
3	1-3-2019	Rev3	E Hansma	R T Benbow
4	11-3-2019	Rev4	E Hansma	R T Benbow

DOCUMENT DISTRIBUTION

Revision	Issue Date	Issued To	Issued By
1	4-12-2018	Goodman Property Services	Benbow Environmental
2	18-2-2019	Goodman Property Services	Benbow Environmental
3	1-3-2019	Goodman Property Services	Benbow Environmental
4	11-3-2019	Goodman Property Services	Benbow Environmental

Head Office:
25-27 Sherwood Street Northmead NSW 2152 Australia
P.O. Box 687 Parramatta NSW 2124 Australia
Telephone: +61 2 9896 0399 Facsimile: +61 2 9896 0544
E-mail: admin@benbowenviro.com.au
Visit our Website at www.benbowenviro.com.au

EXECUTIVE SUMMARY

This document presents a noise impact assessment conducted by Benbow Environmental for the proposed masonry manufacturing plant and warehousing development to be located at 224-398 Burley Road, Horsley Park. The development is proposed to consist of four warehouses and a masonry plant, with access provided off a new estate road.

The nearest receivers and the noise generating activities have been identified. Noise criteria for the project have been formed, with assessment of the proposed site activities conducted against the NSW Noise Policy for Industry (EPA, 2017), NSW Interim Construction Noise Guideline (DECC, 2009) and the NSW Road Noise Policy (DECCW, 2011). Modelling of the activities was conducted using the noise modelling software SoundPlan.

This noise impact assessment finds that predicted noise levels will be below the criteria set out in accordance with the NSW Noise Policy for Industry, at all receivers and time periods. Recommendations for noise controls are given in Section 6, including recommendations for mobile equipment, signage and equipment maintenance.

The generation of additional road traffic associated with the site's activities has been assessed and it was predicted to comply with the guidelines set out in the NSW Road Noise Policy.

During construction works, all activities were predicted to comply with the criteria outlined in the Interim Construction Noise Guideline. Construction activities are recommended to take place during standard construction hours.

No significant vibration impacts are expected during operational activities. During construction works, rollers are recommended to be utilised at least the minimum distances away from neighbouring structures, as per the TfNSW Construction Noise and Vibration Guideline and Table 9-1 of this document.

This report concludes that with the recommendations in this report, the proposed site activities will have an acceptable noise impact on the surrounding receivers. The document addresses the contents in the SEARs as shown in Table 0-1 below.

Table 0-1: Selected SEARs Requirements

SEARs issued for Noise (SEAR No: 1255)	Sections of the Assessment Report Addressing the Relevant SEARs
- A description of all potential noise and vibration sources during construction and operation, including road traffic noise	Section 5.2 (Operational), Section 7 (Road Traffic) and Section 8.3 (Construction)
- A noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines; and	Section 0 to 10
- A description and appraisal of noise and vibration mitigation, management and monitoring measures.	Section 6

Contents Page

Tables Page

Figures Page

Attachments

1. INTRODUCTION

Benbow Environmental has been engaged by Goodman to prepare a noise impact assessment for a proposed warehousing development and masonry manufacturing plant to be located at 224-398 Burley Road, Horsley Park. The Masonry Plant is proposed to have a capacity of 220,000 tonnes per annum and operate 24 hours a day, seven days a week. Four warehouses are proposed to be built to the south and west of the masonry plant.

The principal noise sources associated with the site include noise from truck movements and forklifts associated with the warehouses and masonry plant. Noise will also be generated from the plant equipment and external crushing operations associated with the masonry plant.

Construction noise levels from excavation, concreting and building works are predicted. The noise road traffic impacts of the site on nearby receivers are analysed. Potential vibration impacts during construction and operations are also predicted.

The potential noise impacts of operational, construction and road traffic activities on the nearby receivers have been predicted utilising noise modelling software, SoundPlan. This noise impact assessment has been prepared in accordance with the following guidelines and documents:

- NSW Noise Policy for Industry (EPA, 2017);
- NSW Road Noise Policy (RNP) (DECCW, 2011);
- NSW Interim Construction Noise Guideline (DECC, 2009);
- Fairfield Citywide Development Control Plan (DCP) (Fairfield City Council, 2013); and
- British Standard BS 7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*'.

1.1 SCOPE OF WORKS

This noise impact assessment has been limited to the following scope of works:

a) Review of proposed plans and operations;
b) Long term and short term ambient and background noise monitoring in accordance with relevant guidelines;
c) Identify project specific noise levels;
d) Determine all potential noise sources associated with the proposed development;
e) Collect required noise source data;
f) Predict potential noise impacts at the nearest potentially affected receptors to the site;
g) Assess potential noise impacts against relevant legislation and guidelines;
h) Recommend control measures where required; and
i) Compile this report with concise statements of potential noise impact.

To aid in the review of this report, supporting documentation has been included within the Attachments. A glossary of terminology is included in Attachment 1.

2. PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The subject site is located at 224-398 Burley Road, Horsley Park described as Lot 1 in DP 843901. The site is located approximately 35 kilometres west of the Sydney central business district, within the local government area of Fairfield City Council. Figure 2-2 shows the location of the subject site.

2.2 HOURS OF OPERATIONS

The facility is seeking approval to operate 24 hours a day, seven days a week.

2.3 PROPOSAL DESCRIPTION

The proposal will consist of the construction and operation of four warehouses and a masonry manufacturing plant. The masonry plant is proposed to have a capacity of 220,000 tonnes per annum.

The warehouses will involve trucks delivering and dropping off products. Forklifts will assist in unloading goods into the warehouse and loading goods into the trucks.

The masonry plant involves material deliveries of aggregates and sands from driving trucks over underground storage bins to the north of the site. Cements and powders are delivered to the site in tanker trucks which pneumatically transfer the powdered material to the storage silos located adjacent to the eastern side of the Masonry Plant. The crushing plant, located on the north side of the Masonry Plant, is used to crush masonry product for reuse in the plant. The crushed materials and aggregates get conveyed inside the building and the cement and powders get pneumatically transferred where the material is first mixed into various grades of concrete product.

The concrete slurry is transferred to the block machine which hydraulically presses the material into the desired blocks. The press is proposed to be located inside an acoustic enclosure. The product is transferred via fingerlifts to the curing chambers at the centre of the building. The chambers control the humidity and temperature to ensure the desired mechanical properties of the product are achieved. After the curing process the material are transferred via fingerlifts to the finishing lines located to the west of the curing chambers. Some products undergo additional processing such as polishing and splitting.

Once the finishing process is complete the batches are palletised and transferred outside for storage in the hardstand storage area, truck loading and final distribution.

The site plan of the warehouses and masonry plant is shown in the following figure:

Figure 2-1: Site plan

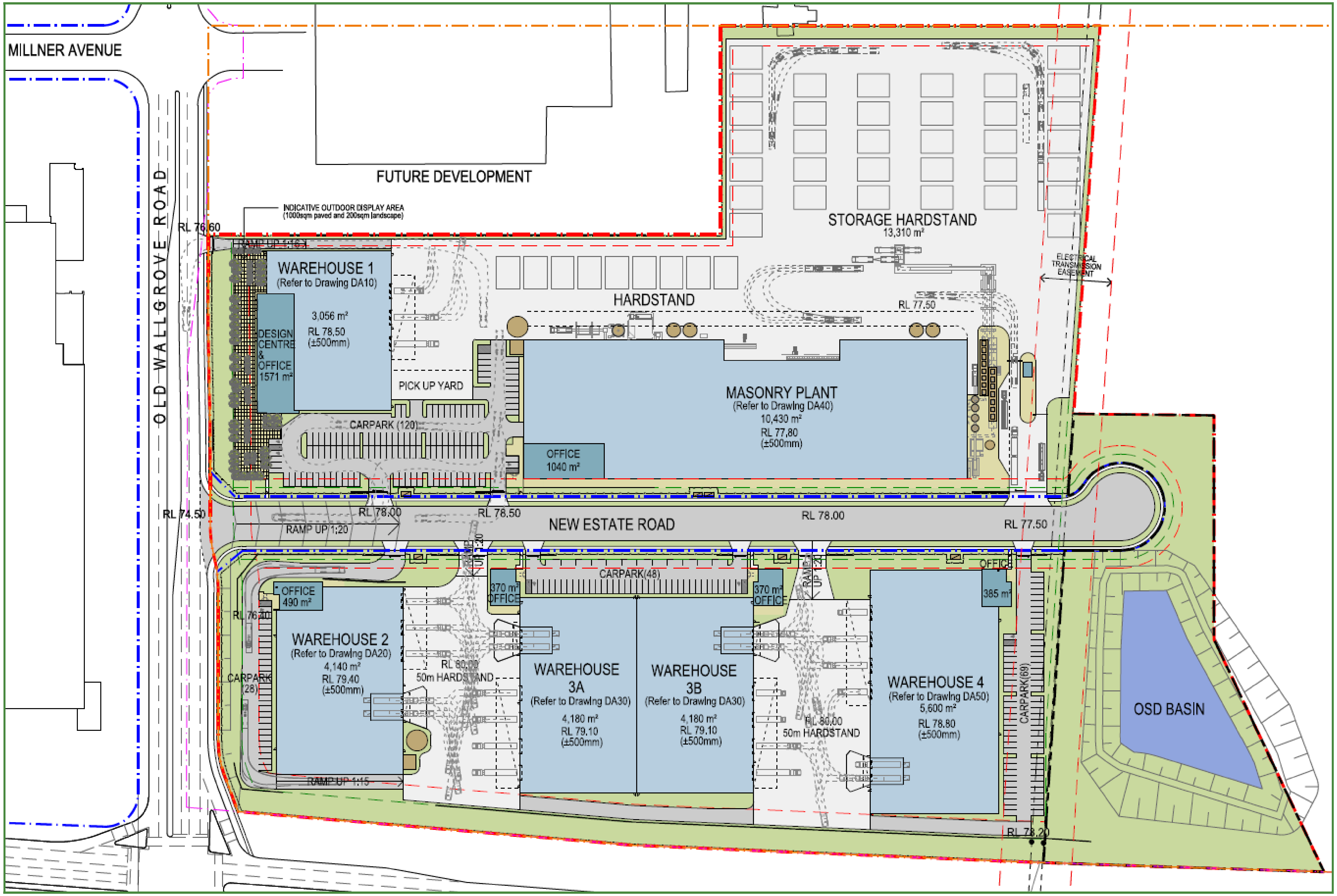


Figure 2-2: Site Location

Source: SIX Maps 2018

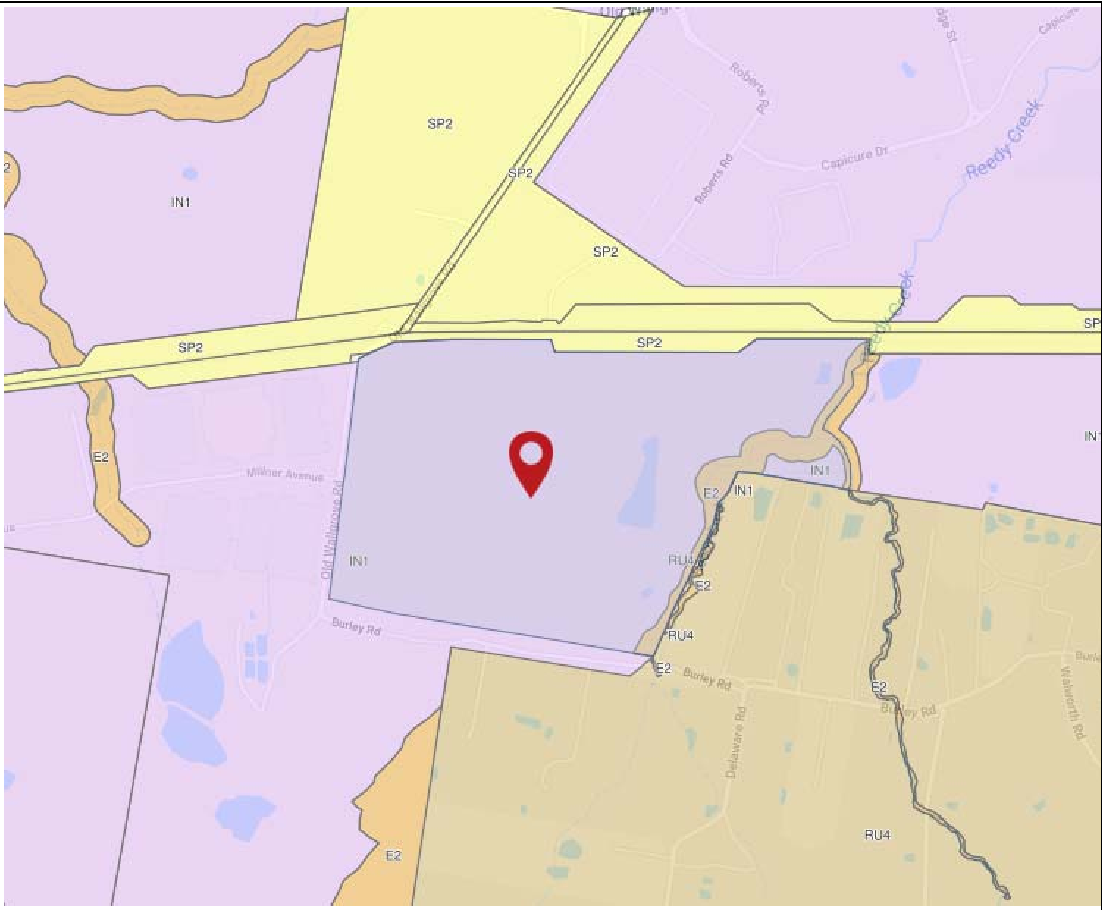
↑N Not to scale	**Legend**: Site Boundaries	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

2.4 DESCRIPTION OF THE SURROUNDING AREA

The land is zoned as IN1 General Industrial under Fairfield Local Environmental Plan 2013 with an area of E2 Environmental Conservation along the eastern boundary.

Two industrial properties, a DHL warehouse and PGH Bricks and Pavers, located to the west and south respectively, are both zoned IN1 General Industrial. The residential properties and agriculture to the south-east are zoned Primary Production Small Lots and an area of SP2 Infrastructure runs along the northern boundary. A land zoning map is provided in the following figure.

Figure 2-3: Land Zoning Map



Source: NSW Planning Portal 2018

↑N

Not to scale

Legend:

Zone

B1	Neighbourhood Centre
B2	Local Centre
B4	Mixed Use
B5	Business Development
B7	Business Park
E1	National Parks and Nature Reserves
E2	Environmental Conservation
E3	Environmental Management
E4	Environmental Living
IN1	General Industrial
IN2	Light Industrial
IN3	Heavy Industrial
R2	Low Density Residential
R3	Medium Density Residential
R5	Large Lot Residential
RE1	Public Recreation
RE2	Private Recreation
RU1	Primary Production
RU2	Rural Landscape
RU3	Forestry
RU4	Primary Production Small Lots
SP1	Special Activities
SP2	Infrastructure
SP3	Tourist

Benbow Environmental
25-27 Sherwood Street,
Northmead NSW 2152

2.5 NEAREST SENSITIVE RECEPTORS

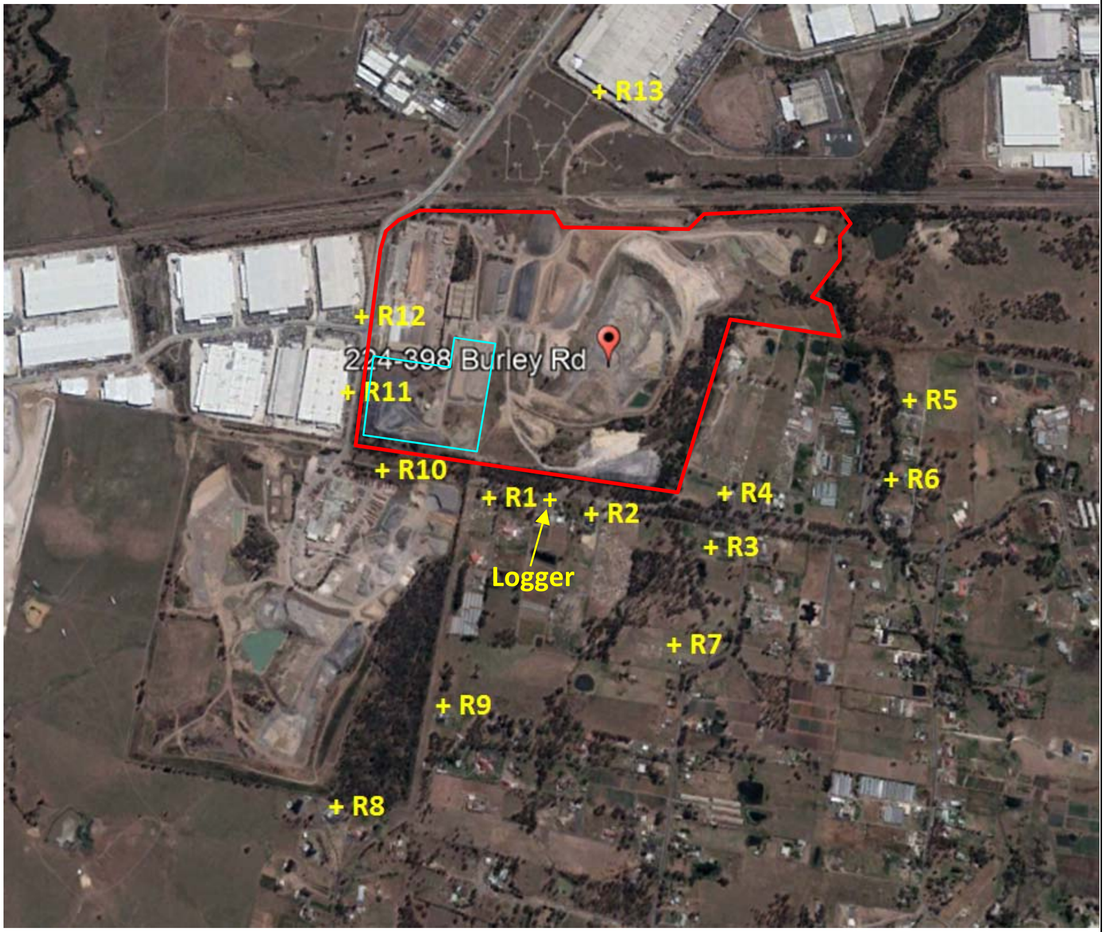
Table 2-1 lists the location of representative potentially affected receivers that are considered in this assessment. The locations are shown in Figure 2-4.

Table 2-1: Table of Nearest Receptors

Receptor ID	Address	Direction from Site	Lot and DP	Approximate distance to proposed development	Type of receiver
R1	321-325 Burley Road, Horsley Park	SE	70 DP8830389	80 m	Residential
R2	251-255 Burley Road, Horsley Park	ESE	22 DP1050695	250 m	Residential
R3	401-403 Delaware Road, Horesley Park	ESE	23 DP867511	570 m	Residential
R4	198-222 Burley Road Horsley Park	E	237 DP13905	590 m	Residential
R5	146 Burley Road, Horsley Park	ENE	2404 DP1090132	1070 m	Residential
R6	138-140 Burley Road, Horsley Park	E	2401 DP1090132	1080 m	Residential
R7	353-371 Delaware Road, Horsley Park	SE	231B DP17288	695 m	Residential
R8	44-46 Greenway Place Horsley Park	S	81 DP1023744	1000 m	Residential
R9	253-255 Delaware Road, Horsley Park	S	141 DP880131	695 m	Residential
R10	327 Burley Road, Horsley Park	S	2 DP1228114	75 m	Industrial
R11	1 Milner Avenue, Oakdale Industrial Estate, Horsley Park	W	3 DP1237058	45 m	Industrial
R12	2 Milner Avenue, Oakdale Industrial Estate, Horsley Park	NW	1 DP1237058	135 m	Industrial
R13	10 Roberts Road, Eastern Creek	NE	553 DP1110447	1040 m	Industrial

Note: distances measured from the boundaries of the proposed masonry plant

Figure 2-4: Map of Nearest Receptors



Source: Google Earth 2018

↑N Not to scale	**Legend:** Site location (red) Proposed site development (cyan)	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

2.6 CONSULTATION

No other consultation other than communication with residents where the logger was located has been undertaken.

3. EXISTING ACOUSTIC ENVIRONMENT

The level of background noise varies over the course of any 24 hour period, typically from a minimum at 3.00am to a maximum during morning and afternoon traffic peak hours. Therefore the NSW EPA Noise Policy for Industry (2017) requires that the level of background and ambient noise be assessed separately for the daytime, evening and night time periods. The Noise Policy for Industry defines these periods as follows:

- **Day** – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays;
- **Evening** – the period from 6pm to 10pm; and
- **Night** – the remaining periods.

3.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

Background noise level measurements were carried out using a Svantek SVAN 957 Precision Sound Level Meter (attended noise monitoring) and one (1) Acoustic Research Laboratories statistical Environmental Noise Logger, type EL-215 (unattended noise monitoring). The instrument sets were calibrated by a NATA accredited laboratory within two years of the measurement period. Calibration certificates have been included in Attachment 2.

To ensure accuracy and reliability in the results, field reference checks were applied both before and after the measurement period with an acoustic calibrator. There were no excessive variances observed in the reference signal between the pre-measurement and post-measurement calibration. The instruments were set on A-weighted Fast response and noise levels were measured over 15-minute statistical intervals. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in Attachment 3. The microphones were fitted with windsocks and were positioned between 1.2 metres and 1.5 meters above ground level.

3.2 MEASUREMENT LOCATION

Unattended long-term noise monitoring was undertaken from 19th October 2018 to 30th October 2018 at one representative location, 263-273 Burley Road, Horsley Park.

Attended noise monitoring was undertaken at the same location on 19th October 2018. The attended and noise logging locations are shown in Figure 2-4. Noise Logger Charts are presented in Attachment 3.

3.3 MEASURED NOISE LEVELS

3.3.1 Long-Term Unattended Noise Monitoring Results

The data was analysed to determine a single assessment background level (ABL) for each day, evening and night time period, in accordance with the NSW EPA Noise Policy for Industry. That is, the ABL is established by determining the lowest tenth-percentile level of the L_{A90} noise data over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night assessment periods is based on the median of individual ABL's determined over the entire monitoring period.

The results of the long-term unattended noise monitoring are displayed in Table 3-1. Daily noise logger graphs have been included in Attachment 3.

Table 3-1: Unattended Noise Monitoring Results at Logger Location, dB(A)

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
19/10/2018	63	56	52	54	50	48	35	42	44	60	49	47
20/10/2018	59	-	51	49	-	47	36	-	40	50	-	46
21/10/2018	57	51	49	48	43	44	36	35	36	48	43	44
22/10/2018	60	55	47	49	49	44	36	39	35	51	50	43
23/10/2018	61	56	49	52	49	45	39	39	37	50	52	46
24/10/2018	60	52	50	49	44	44	39	37	36	51	44	45
25/10/2018	58	55	48	49	47	42	37	39	34	49	47	44
26/10/2018	-	51	51	-	45	44	-	38	35	-	45	47
27/10/2018	59	-	48	49	-	43	35	-	35	49	-	43
28/10/2018	-	51	46	-	43	42	-	36	35	-	45	42
29/10/2018	58	55	47	48	47	44	36	38	35	49	47	43
30/10/2018	-	-	48	-	-	45	-	**-**	**37**	-	**-**	**47**
Average	**59**	**54**	**49**	**50**	**46**	**44**	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**36**	**38**	**35**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**53**	**48**	**45**

Note: - indicates values that has not been considered due to adverse weather conditions.
* Indicates values that are not relevant to that noise descriptor.
Value in bold indicates relevant noise descriptor.

3.3.2 Short-Term Attended Noise Monitoring Results

Given that the results of the unattended noise monitoring are affected by all ambient noise sources such as local fauna, road traffic and industrial sources, it is not possible to determine with precision the exact existing industrial noise contribution based on unattended monitoring alone. Therefore, the attended noise monitoring allows for a more detailed understanding of the existing ambient noise characteristics and a more meaningful final analysis to be undertaken. The results of the short-term attended noise monitoring are displayed in Table 3-2.

Table 3-2: Attended Noise Monitoring Results, dB(A)

Location / Time	Noise Descriptor				Comments
	L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	
263-273 Burley Road, Horsely Park	52	38	55	64	*Van passing along road < 63 dB(A)* *Car passing along fenceline< 51 dB(A)* *Excavator from Austral plant 48-51 dB(A)* *Staff talking near Austral fenceline < 47 dB(A)* *Hand tools near Austral fenceline < 51 dB(A)* *Birds < 61 dB(A)* *Planes overhead < 65 dB(A)* *Helicopters overhead < 69 dB(A)* *Noise Dominated by Aircraft*

3.4 PHOTOGRAPH

Figure 3-1 shows the location of the noise monitoring instrumentation at 263-273 Burley Road, Horsley Park.

Figure 3-1: Monitoring location

4. CURRENT LEGISLATION AND GUIDELINES

4.1 NSW EPA Noise Policy for Industry

4.1.1 Introduction

The NSW Noise Policy for Industry was developed by the NSW EPA primarily for the assessment of noise emissions from industrial sites regulated by the NSW EPA.

The policy sets out two components that are used to assess potential site-related noise impacts. The intrusiveness noise level aims at controlling intrusive noise impacts in the short-term for residences. The amenity noise level aims at maintaining a suitable amenity for particular land uses including residences in the long-term. The more stringent of the intrusiveness or amenity level becomes the project noise trigger levels for the project.

4.1.2 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

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

Where the $L_{Aeq,(15minute)}$ is the predicted or measured L_{Aeq} from noise generated within the project site over a fifteen minute interval at the receptor.

This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30 m from the residence, at the most affected point within 30 m of the residential dwelling.

4.1.3 Amenity Noise Level

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable from the Noise Policy for Industry are reproduced in Table 4-1. The rural category has been selected for the residential noise amenity criteria to match the characteristics of the area.

Table 4-1: Amenity noise levels.

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residential	Rural	Day	50
		Evening	45
		Night	40
Industrial premises	All	When in use	70
Commercial premises	All	When in use	65
Active recreation	All	When in use	55

The project amenity noise level for industrial developments = recommended amenity noise level minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise levels apply:

1. *In areas with high traffic noise levels*
2. *In proposed developments in major industrial clusters*
3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.*
4. *Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for development.*

This development is not considered to be captured by the above exceptions.

4.1.4 Sleep Disturbance Criteria

In accordance with the NSW EPA Noise Policy for Industry, the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

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

a detailed maximum noise level assessment should be undertaken.

4.1.5 Project Noise Trigger Levels

The project noise trigger levels for the site have been established in accordance with the principles and methodologies of the NSW Noise Policy for Industry (EPA, 2017).

The table below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level. Sleep disturbance trigger levels associated with operational activities are presented in Table 4-2.

Different time periods apply for the noise criteria as the intrusive criterion considers a 15 minute assessment period while the amenity criterion requires assessment over the total length of time that a site is operational within each day, evening or night period. In order to ensure compliance under all circumstances, a 15 minute period assessment has been considered for all receptors.

Table 4-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receptor	Time of day	Rating background noise level	Project intrusiveness noise level $L_{eq\ 15\ minute}$	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$[2]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
R1-R9	Residential – Rural	Day	36	**41**	50	48	**41**	**-**
		Evening	38	**41**[1]	45	43	**41**	**-**
		Night	35	40	40	**38**	**38**	**52**
R10-13	Industrial Premises	When in use	**-**	**-**	70	68	**68**	**-**

Notes:
1) The project intrusiveness level for evening time should be no greater than the project intrusiveness level for day time as per the Noise Policy for Industry 2017
2) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period} + 3$ dB (NSW Noise Policy for Industry Section 2.2).

4.2 Fairfield Citywide Development Control Plan – Fairfield City Council

The proposed site sits within the applicable land for the Fairfield Citywide Development Control Plan (DCP) from Fairfield City Council. Noise guidelines contained in Section 9.10.6 of the DCP are therefore applicable to the site.

> ***9.10.6 Noise and Vibration***
>
> *a) Noise and/or vibration generating activities are to be located within buildings or orientated away from residential properties or other sensitive land uses such as child care centres or places of public worship.*
>
> *b) An Acoustic Engineers Report may be required to be prepared as part of a development application where Council considers that the proposed development has the potential to produce an adverse noise and/or vibration impact.*

In November 2017, the Noise Policy for Industry (EPA, 2017) replaced the previous Industrial Noise Policy (EPA, 2000). For both documents, the amenity of the surrounding area and the existing industrial noise sources are taken into account. Criteria to meet the requirements of the Noise Policy for Industry (EPA, 2017) were outlined in Section 4.1. Therefore, by meeting the requirements of the Noise Policy for Industry (EPA, 2017) in Section 4.1, the Fairfield Citywide DCP will also be met.

4.3 NSW Road Noise Policy

The NSW Road Noise Policy (RNP) has been adopted to establish the noise criteria for the potential noise impact associated with additional traffic generated by the proposed development. The RNP was developed by the NSW EPA primarily to identify the strategies that address the issue of road traffic noise from:

- Existing roads;
- New road projects;
- Road redevelopment projects; and
- New traffic-generating developments.

4.3.1 Road Category

The subject site is accessed by Old Wallgrove Road, which is a local road off Wallgrove Road. No residential receivers are located on Old Wallgrove Road, so the closest residential receivers are located along Wallgrove Road.

Based on the RNP road classification description, Wallgrove Road would be classified as a 'sub-arterial road'.

4.3.2 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant sections of Table 3 of the RNP are shown in Table 4-3.

Table 4-3: Road Traffic Noise Assessment Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)*	
		Day (7am-10pm)	Night (10pm-7am)
Sub-arterial Roads	3. Existing residences affected by additional traffic on existing sub-arterial roads generated by land use developments	$L_{Aeq\ (15\ hour)}$ 60 dB	$L_{Aeq\ (9\ hour)}$ 55 dB

* Measured at 1 m from a building façade.

4.3.3 Assessment Locations for Existing Land Uses

Table 4-4: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
External noise levels at residences	The noise level should be assessed at 1 metre from the façade and at a height of 1.5 metres from the floor. Separate noise criteria should be set and assessment carried out for each façade of a residence, except in straightforward situations where the residential façade most affected by road traffic noise can be readily identified. The residential noise level criterion includes an allowance for noise reflected from the façade ('façade correction'). Therefore, when taking a measurement in the free field where reflection during measurement is unlikely (as, for instance, when measuring open land before a residence is built), an appropriate correction – generally 2.5 dB – should be added to the measured value. The 'façade correction' should not be added to measurements taken 1 metre from the façade of an existing building. Free measurements should be taken at least 15 metres from any wall, building or other reflecting pavement surface on the opposite side of the roadway, and at least 3.5 metres from any wall, building or other pavement surface, behind or at the sides of the measurement point which would reflect the sound.
Noise levels at multi-level residential buildings	The external points of reference for measurement are the two floors of the building that are most exposed to traffic noise. On other floors, the internal noise level should be at least 10 dB less than the relevant external noise level on the basis of openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)
Internal noise levels	Internal noise levels refer to the noise level at the centre of the habitable room that is most exposed to the traffic noise with openable windows being opened sufficiently to provide adequate ventilation. (Refer to the Building Code of Australia (Australian Building Codes Board 2010) for additional information.)

Table 4-4: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
Open space – passive or active use	The noise level is to be assessed at the time(s) and location(s) regularly attended by people using the space. In this regard, 'regular' attendance at a location means at least once a week.

4.4 CONSTRUCTION NOISE AND VIBRATION CRITERIA

Criteria for construction and demolition noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from British Standard BS 7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' and other standards.

4.4.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels are reproduced in Table 4-5 below. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected' noise management level.

Table 4-5: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
Recommended standard hours: Monday to Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15\ minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residents. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise Affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 (RNP)

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. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m from the residence.

Other Land Uses

Table 4-6 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 4-6: Management Levels at Other Land Uses

Land use	Management Level $L_{Aeq(15\ minute)}$ (applies when properties are being used)
Industrial Premises	External Noise Level 75 dB(A)

There are no other sensitive land uses in the area surrounding the site.

The noise criterion for construction noise is presented in Table 4-7.

Table 4-7: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R9	Residential	Standard Hours	35	45
R10-R13	Industrial	Standard Hours	-	75

4.4.2 Vibration Criteria

Vibration criteria from construction works are outlined in this section, including guidelines to avoid cosmetic damage, structural damage or human discomfort. There is no specific vibration standard in NSW to assess cosmetic or structural damage to buildings. Usually the British Standard BS 7385–Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' or the German standard DIN4150–Part 3: 1999 '*Structural Vibration Part 3 – effects of vibration on structures*' is referenced. The *Assessing Vibration – A Technical Guideline* (DEC, 2006) provides guidance on preferred levels for human exposure.

4.4.3 BS 7385–2:1993

The British Standard BS 7385–Part 2:1993 '*Evaluation and measurement for vibration in buildings*' provides vibration limits to avoid cosmetic damage on surrounding structures. Limits are set at the lowest limits where cosmetic damage has previously been shown.

Table 4-8: Vibration criteria for cosmetic damage (BS 7385:2 1993)

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

4.4.4 DIN4150–3:1999

The German standard DIN4150-Part 3:1999 '*Structural Vibration* Part 3 – *Effects of vibration on structures*' has also been considered. The German standard is considered more onerous than the British standard, and specifically includes more stringent limits to avoid structural damage to surrounding heritage buildings.

Table 4-9: Structural damage criteria heritage structures (DIN4150-3 1999)

Type of building	Peak component particle velocity (PPV) mm/s			
	Vibration at the foundation at a frequency of:			Vibration of horizontal plane of highest floor at all frequencies
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	
Buildings used for commercial purposes, industrial buildings or buildings of similar design	20	20 to 40	40 to 50	40
Residential dwellings and similar	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified as the two categories above, and are of intrinsic value (for example heritage listed buildings).	3	3 to 8	8 to 10	8

4.4.5 Human Exposure

The guideline *Assessing Vibration – A Technical Guideline* (DEC, 2006) describes preferred criteria for human exposure. The limits describe values where occupants of buildings would be impacted by construction work.

Table 4-10: Preferred and maximum weighted rms z-axis values, 1-80 Hz

Location	Daytime		Night time	
	Preferred	Maximum	Preferred	Maximum
Continuous Vibration (weighted root mean square (rms) vibration levels for continuous acceleration (m/s^2) in the vertical direction)				
Residences	0.01	0.02	0.007	0.014
Offices, schools, educational institutions and places of worship	0.02	0.04	0.02	0.04
Workshops	0.04	0.08	0.04	0.08
Impulsive Vibration (weighted root mean square (rms) vibration levels for impulsive acceleration (m/s^2) in the vertical direction)				
Residences	0.3	0.6	0.1	0.2
Offices, schools, educational institutions and places of worship	0.64	1.28	0.64	1.28
Workshops	0.64	1.28	0.64	1.28
Intermittent Vibration (m/s)				
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

4.5 METEOROLOGICAL FACTORS

Wind and temperature inversions may affect the noise emissions from the site and are to be incorporated in the assessment when considered to be a feature of the area.

In this section, an analysis of the 2018 weather data has been conducted to establish whether significant winds are characteristic of the area.

4.5.1 Wind Effects

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30% or more of the time in any assessment period in any season.

4.5.2 Wind Rose Plots

Wind rose plots show the direction that the wind is coming from, with triangles known as "petals". The petals of the plots in the figures summarise wind direction data into 8 compass directions i.e. north, north-east, east, south-east, etc. The length of the triangles, or "petals", indicates the frequency that the wind blows from that direction. Longer petals for a given direction indicate a higher frequency of wind from that direction. Each petal is divided into segments, with each segment representing one of the six wind speed classes.

Thus, the segments of a petal show what proportion of wind for a given direction falls into each class. The proportion of time for which wind speed is less than 0.5 m/s, when speed is negligible, is referred to as calm hours or "calms". Calms are not shown on a wind rose as they have no direction, but the proportion of time consisting of the period under consideration is noted under each wind rose.

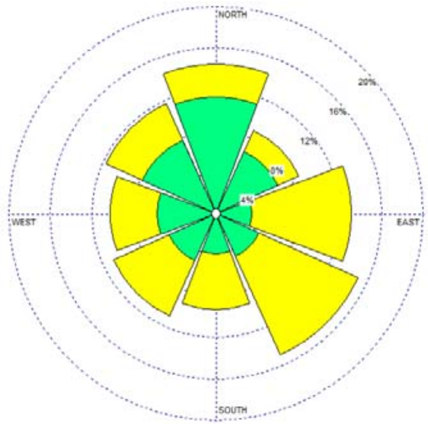
The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

4.5.3 Local Wind Trends

Seasonal wind rose plots for this site utilising Horsley Park Equestrian Centre AWS data have been included in Figure 4-1, Figure 4-2 and Figure 4-3 for day, evening and night periods respectively.

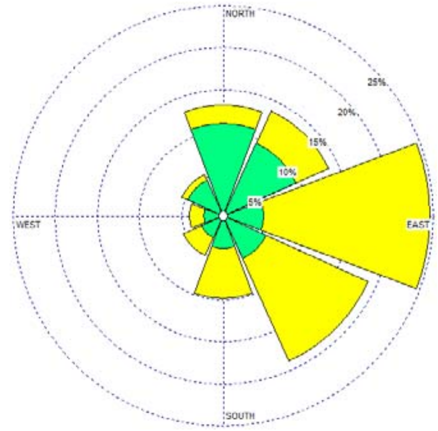
Figure 4-1: Wind Rose Plots– Bureau of Meteorology Horsley Park 2018 Daytime (7:00-18:00)

All Seasons



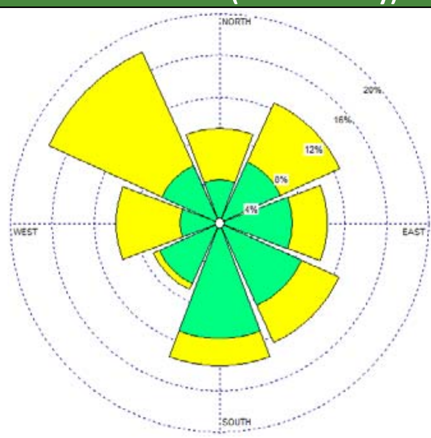
Average Wind Speed: 2.89 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Summer Season (December – February)



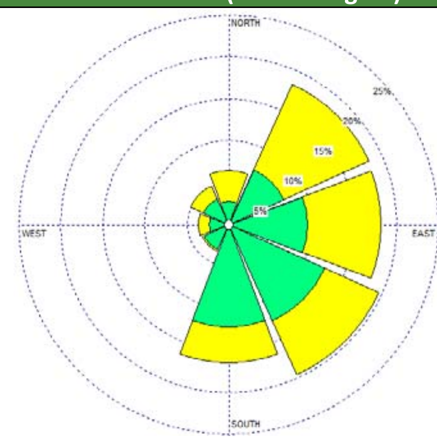
Average Wind Speed: 3.19 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)



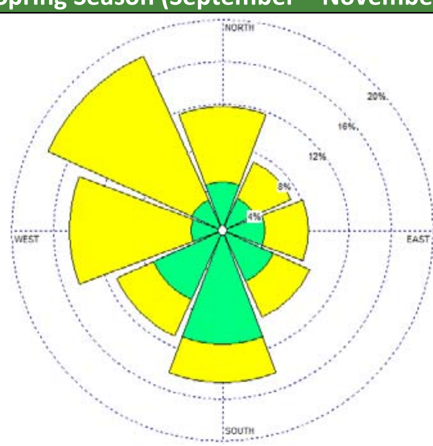
Average Wind Speed: 2.63 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Winter Season (June – August)



Average Wind Speed: 2.64 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Spring Season (September – November)



Average Wind Speed: 3.12 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Legend

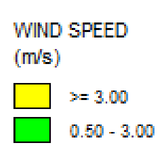
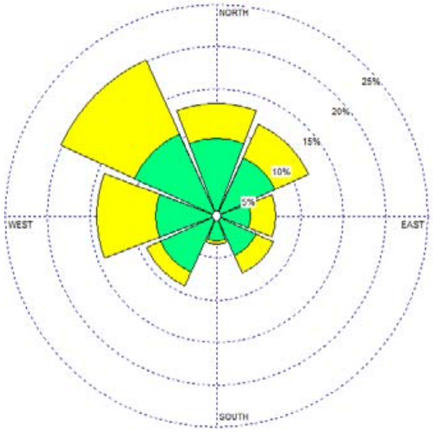


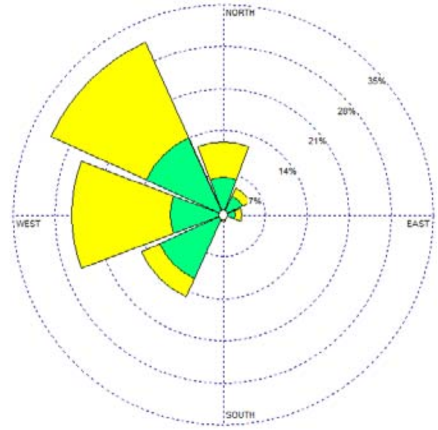
Figure 4-2: Wind Rose Plots– Bureau of Meteorology Horsley Park 2018 Evening (18:00-22:00)

All Seasons



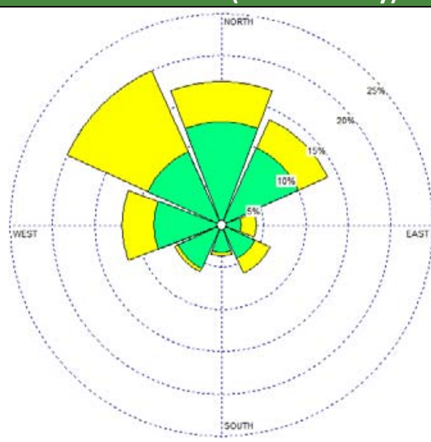
Average Wind Speed: 2.25 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Summer Season (December – February)



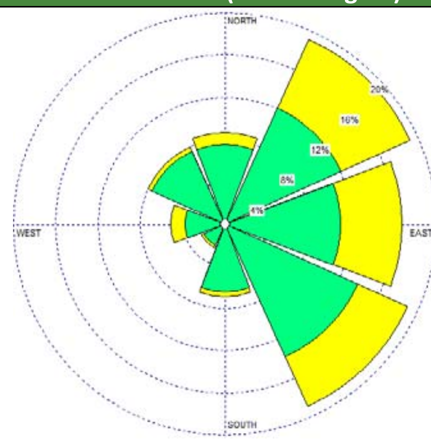
Average Wind Speed: 2.81 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Autumn Season (March – May)



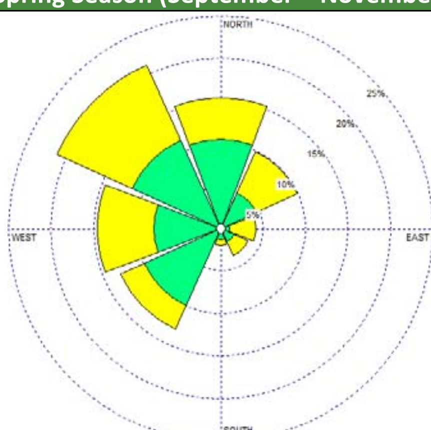
Average Wind Speed: 2.00 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Winter Season (June – August)



Average Wind Speed: 1.91 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Spring Season (September – November)



Average Wind Speed: 2.28 m/s
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Legend

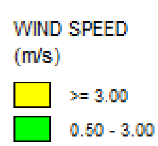
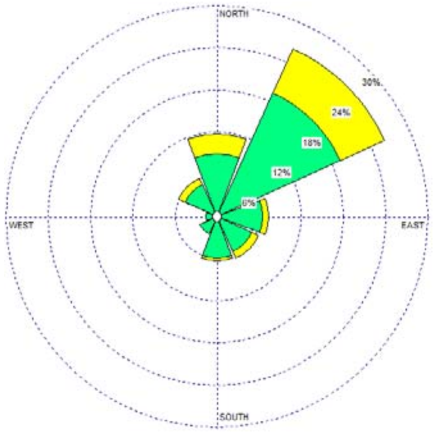


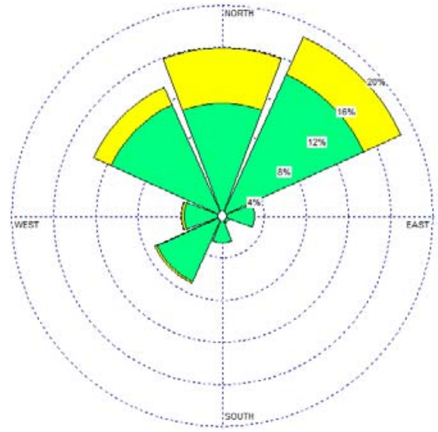
Figure 4-3: Wind Rose Plots– Bureau of Meteorology Horsley Park 2018 Night (22:00-7:00)

All Seasons



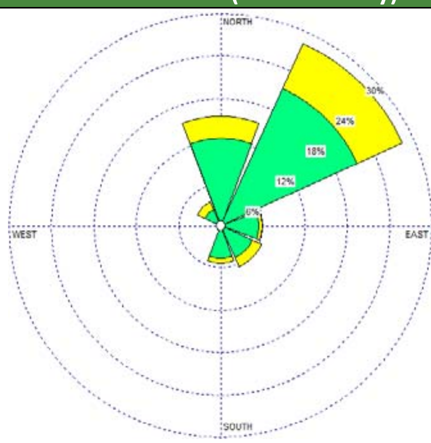
Average Wind Speed: 1.35 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Summer Season (December – February)



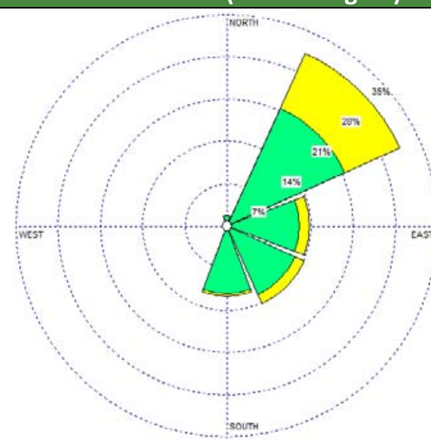
Average Wind Speed: 1.21 m/s
Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Autumn Season (March – May)



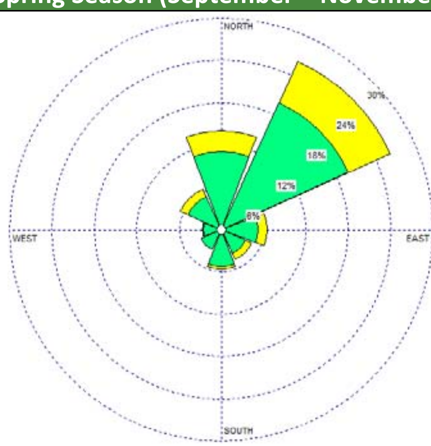
Average Wind Speed: 1.34 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Winter Season (June – August)



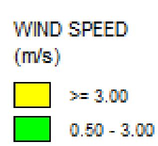
Average Wind Speed: 1.48 m/s
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Spring Season (September – November)



Average Wind Speed: 1.38 m/s
Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Legend



Based on the information presented from the weather data, source-to receiver wind speeds of 3 m/s or are not present for more than 30% of the time during any time period or season. Therefore, wind effects have not been included in the assessment.

4.6 Temperature Inversions

Temperature inversions are considered a feature where they occur more than 30% of the total night time during winter (June, July and August) between 6:00pm and 7:00am. This is different from the night noise assessment period over which inversions are to be assessed, which is from 10:00pm to 7:00am.

This involves determining the percentage occurrence of moderate (Class F) and strong (Class G) inversions. Weak inversions (Class E) should not be included in the analysis.

The analysis conducted on the 2018 weather data highlighted that during winter 18.3% of the nights presented temperature inversion conditions, therefore these effects have not been included in the noise impact assessment.

4.6.1 Weather Conditions Considered in the Assessment

The following condition was considered:

- Condition A: neutral weather conditions

The meteorological condition considered in the noise model has been displayed in detail in Table 4-11.

Table 4-11: Meteorological Conditions Assessed in Noise Propagation Modelling

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receptors	Applicability
A	Neutral	10°C	70%	–	–	No	All	All periods

5. OPERATIONAL NOISE IMPACT ASSESSMENT

An outline of the predictive noise modelling methodology and operational noise modelling scenarios for the warehouses and masonry plant has been provided in this section of the report.

5.1 MODELLING METHODOLOGY

Predictive Noise Modelling was carried out using the Concawe algorithm within SoundPLAN. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for numerous sites, and is recognised by regulatory authorities throughout Australia.

Inputs into the noise model include topographical features of the area, ground absorption, on site structures and predicted noise sources. Receivers were included to predict the noise emissions of the proposed development at the nearest potentially affected residences.

The modelling scenario has been carried out using the L_{Aeq} and L_{Amax} descriptors. Using the model, noise levels were predicted at the potentially most affected receivers to determine the noise impact against the project specific noise levels and other relevant noise criteria in accordance with the NSW Noise Policy for Industry (EPA, 2017).

5.2 NOISE SOURCES

The sound power levels for the identified noise sources associated with the operational activities have been taken from equipment datasheets, on-site measurements of similar activities as well as from Benbow Environmental's database.

A-weighted third octave band centre frequency sound power levels have been used and are presented in Table 5-1 below. The noise sources utilised as part of this assessment comprise of the primary noise generating activities associated with the effective operation of the proposed development.

Table 5-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	L_{Amax}	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Forklift	103	92	36	59	61	51	65	66	77	68	60	62
			66	69	74	81	78	78	81	85	84	84
			81	75	71	71	65	63	56	51	45	42
Aggregate & Waste Dumping	110	106	-	65	-	-	72	-	-	77	-	-
			84	-	-	91	-	-	95	-	-	98
			-	-	100	-	-	102	-	-	95	-
Front End Loader	109	102	44	51	59	85	84	77	77	78	80	85
			89	85	85	88	88	90	93	94	93	92
			91	90	88	87	84	81	77	73	66	60

Table 5-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	L_{Amax}	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Crusher	114	108	50	63	68	75	82	86	91	94	97	97
			91	90	94	99	101	98	96	97	96	94
			92	89	86	84	81	78	75	71	67	62
Cement Blower	107	104	31	54	54	57	68	63	65	76	72	71
			75	75	82	84	96	100	90	92	91	92
			90	88	86	84	81	82	74	-	-	-
Conveyor	86	80	29	31	29	35	38	49	45	49	53	57
			57	65	68	70	68	71	70	72	71	70
			63	63	59	56	52	49	44	42	36	29
Finger Cart	-	92	36	59	61	51	65	66	77	68	60	62
			66	69	74	81	78	78	81	85	84	84
			81	75	71	71	65	63	56	51	45	42
Concrete Mixing	-	104	37	48	49	56	72	62	71	75	74	82
			83	84	91	93	91	95	97	95	93	94
			91	89	89	86	84	81	78	-	-	-
Boiler	-	96	50	45	48	60	59	72	77	74	79	79
			79	78	84	85	82	83	83	84	84	83
			84	86	85	80	81	78	82	81	82	73
Washing Device	-	81	43	33	33	52	44	49	55	56	62	67
			65	71	70	72	71	72	71	70	68	67
			66	64	62	60	59	54	53	46	45	36
Polisher	-	84	46	36	36	55	47	52	58	59	65	70
			68	74	73	75	74	75	74	73	71	70
			69	67	65	63	62	57	56	49	48	39
Chamfering	-	95	57	47	47	66	58	63	69	70	76	81
			79	85	84	86	85	86	85	84	82	81
			80	78	76	74	73	68	67	60	59	50
Shot Blasting	-	95	57	47	47	66	58	63	69	70	76	81
			79	85	84	86	85	86	85	84	82	81
			80	78	76	74	73	68	67	60	59	50
Curling	-	78	40	30	30	49	41	46	52	53	59	64
			62	68	67	69	68	69	68	67	65	64
			63	61	59	57	56	51	50	43	42	33
Drying Tunnel	-	91	53	43	43	62	54	59	65	66	72	77
			75	81	80	82	81	82	81	80	78	77
			76	74	72	70	69	64	63	56	55	46
Top Seal	-	79	41	31	31	50	42	47	53	54	60	65
			63	69	68	70	69	70	69	68	66	65
			64	62	60	58	57	52	51	44	43	34
Splitter	-	102	64	54	54	73	65	70	76	77	83	88
			86	92	91	93	92	93	92	91	89	88
			87	85	83	81	80	75	74	67	66	57

Table 5-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	L_{Amax}	Overall	Third Octave Band Centre Frequency (Hz)									
			25	31	40	50	63	80	100	125	160	200
			250	315	400	500	630	800	1000	1250	1600	2000
			2500	3150	4000	5000	6300	8000	10000	12500	16000	20000
Press Machine (with enclosure)	-	105	-	-	-	-	81	-	-	85	-	-
			92	-	-	97	-	-	100	-	-	100
			-	-	93	-	-	79	-	-	-	-
Small fan	75	72	37	40	44	44	46	49	49	55	59	57
			58	60	61	61	62	63	62	61	61	60
			58	56	52	46	43	38	34	28	24	20
Truck Engine Manoeuvering	109	103	44	48	57	65	70	73	78	78	80	82
			83	85	94	98	94	96	89	88	82	87
			85	84	82	83	83	82	78	-	-	-
Truck Exhaust Manoeuvering	103	101	42	46	55	63	68	71	76	76	78	80
			81	83	92	96	92	94	87	86	80	85
			83	82	80	81	81	80	76	-	-	-

5.2.1 Modelling Scenario

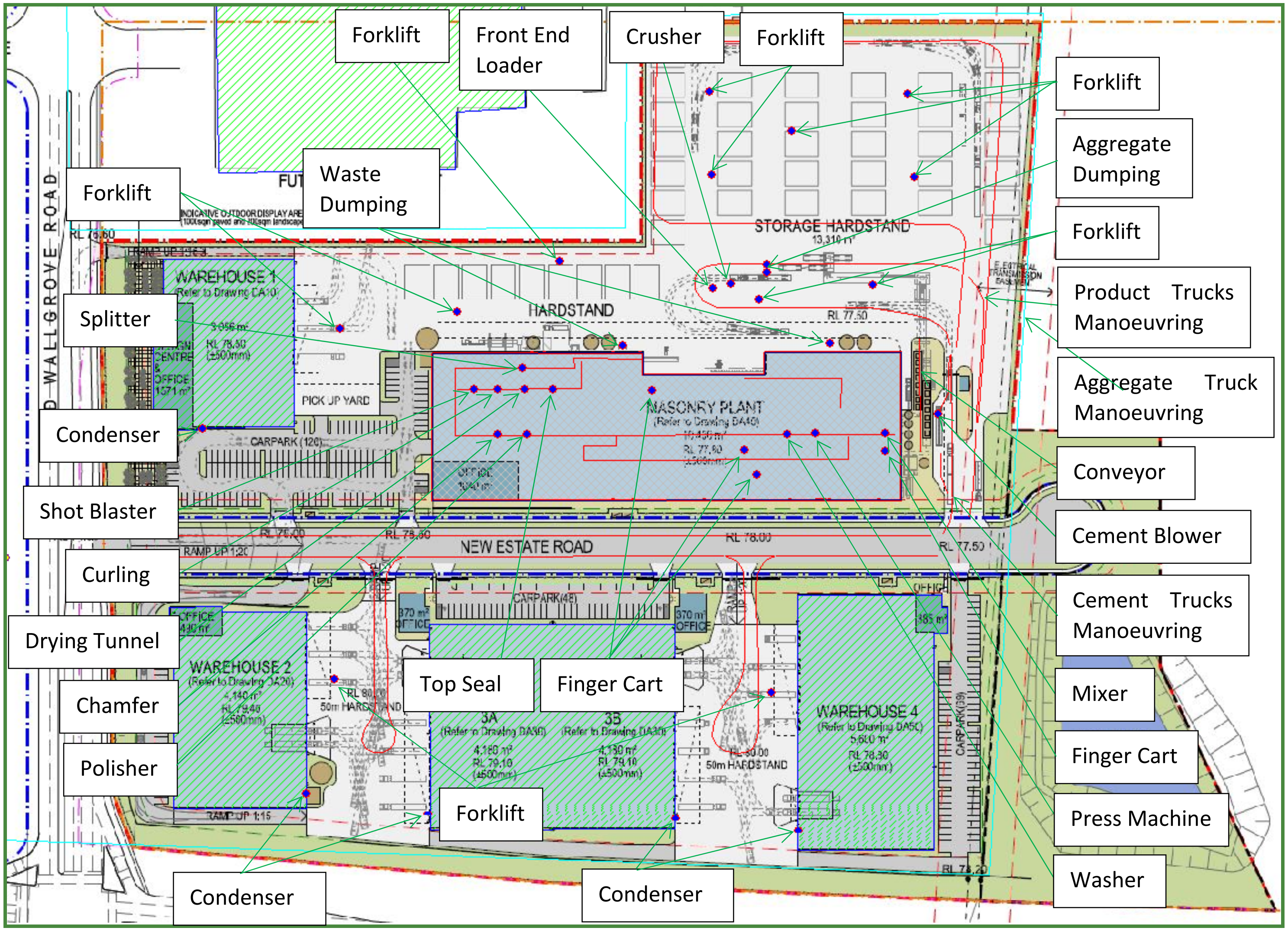
One scenario was modelled for operational noise emissions. The scenario covers proposed day, evening and night operations of the warehouses and masonry plant, including proposed heavy vehicle movements, and indoor sources.

Table 5-2: Modelled Noise Sources

Scenario	Description
Scenario 1: Operations	This scenario includes the following: • Heavy vehicle movements including aggregate deliveries, cement deliveries and final product pickup; • Use of the crushing plant; • Use of 12 external forklifts; • Use of external front end loader; • Use of internal plant; and • Air conditioning condenser units for warehouses.

Figure 5-1 shows the locations of the noise sources for the operational scenario.

Figure 5-1: Scenario 1 – Warehouse and Masonry Plant Operations



5.2.2 Modelling Assumptions

The relevant assessment period for operational noise emissions is 15 minutes when assessing noise levels against the Intrusive Criterion; therefore noise source durations detailed throughout the following assumptions section should be considered per 15 minute period in view of potential noise impacts under worst-case scenarios. Each assessment-specific assumption has been detailed below:

- Off-site topographical information has been obtained from Google Earth and implemented in SoundPLAN.

- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The site and surrounding industrial areas have been modelled with a ground absorption factor of 0 (hard). The surrounding grasslands area has been modelled with a ground absorption factor of 1.0 (soft).

- 2 × aggregate truck and dog, 1 × cement tanker, 2 × product trucks to the masonry plant and 2 x normal trucks to the warehouses are assumed to enter and leave the site every 15 minutes (28 per hour). Trucks have been assumed to travel on the site at 20 km/h.

- 3 of the forklifts are assumed to operate at the warehouses, the remainder are assumed to operate at the masonry plant;

- The aggregate & waste dumping is assumed to occur for 2 minutes every hour.

- All other sources are assumed to operate 100% of the time as a worst case scenario.

- The production building has been modelled with 1 mm sheet steel (R_w 25 dB). All pedestrian doors, roller shutter doors and output doors have been modelled open (R_w 0 dB) 100% of the time. Doors are as per elevation drawings.

- Warehouses feature small air conditioning condenser units that operate for 100% of the 15 minute period;

- All residential receivers were modelled at 1.5 m above ground level at the most noise-affected point within the property boundary.

- The enclosure around the press machine will consist of masonry block (R_w 40 dB). The roof is to be of materials at least (R_w 35 dB). Openings for product in and out of the enclosure, windows and doors are to be minimised where possible. Any windows are to be at least 10 mm (R_w 33 dB). Doors are to be at least solid core 38 mm thick plywood door, with a soft plastic gasket around the sides and top and drop seal at the base (R_w 28 dB). Half of the walls and ceiling space of the enclosure is to be covered with absorptive material of at least NRC = 0.6.

5.3 PREDICTED NOISE LEVELS – OPERATIONAL

Noise levels at the nearest receptors have been calculated and results of the predictive noise modelling considering operational activities are shown in Table 5-3. The modelled scenario is predicted to comply with the $L_{eq(15\ minute)}$ project specific criteria at all sensitive receptors. Exceedance of the L_{AMax} sleep disturbance is not predicted at any residential receptors.

Table 5-3: Predicted Noise Levels – Operational Activities dB(A)

Receptor	Project Criteria $L_{eq(15\ minute)}$			Project Criteria L_{Amax}	Scenario 1	
	Day	Evening	Night		Predicted $L_{eq(15\ minute)}$	Predicted L_{Amax}
R1	41	41	38	52	38 ✓	43 ✓
R2	41	41	38	52	31 ✓	36 ✓
R3	41	41	38	52	32 ✓	37 ✓
R4	41	41	38	52	31 ✓	36 ✓
R5	41	41	38	52	30 ✓	35 ✓
R6	41	41	38	52	30 ✓	35 ✓
R7	41	41	38	52	30 ✓	35 ✓
R8	41	41	38	52	23 ✓	28 ✓
R9	41	41	38	52	25 ✓	31 ✓
R10	68			NA	44 ✓	NA
R11	68			NA	56 ✓	NA
R12	68			NA	45 ✓	NA
R13	68			NA	33 ✓	NA

✓Complies ✗ Non-compliance

6. RECOMMENDED MITIGATION MEASURES

The noise assessment in Section 5 predicted that if the assumptions listed in 5.2.2 are carried out, noise levels would be met at all surrounding receivers during all considered weather conditions.

While further noise mitigation measures are not required to meet the project criteria, the following noise control measures are recommended in order to proactively further reduce noise levels at surrounding receivers:

- Replacement of beeping reversing alarms on all vehicles which are regularly used on site (the forklift and front end loader) with reversing lights or a white noise reversing alarm (squawker).
- Prohibition of extended periods of on-site revving/idling;
- Minimisation of the use of truck exhaust brakes on site;
- Enforcement of low on-site speed limits;
- Signs to encourage quiet operations during the night period; and
- On-site mobile equipment to be maintained in accordance with a preventative maintenance program to ensure optimum performance and early detection of wearing or noisy components.

7. ROAD TRAFFIC NOISE IMPACT ASSESSMENT

A description of the calculation methodology and the noise predictions associated with road traffic has been provided below.

Trucks access the site from Old Wallgrove Road. With no residential receptors along Old Wallgrove Road, the nearest residential receptors along the truck route are assumed to be along Wallgrove Road. Road traffic noise impacts have been analysed at the potentially most impacted road traffic receiver at 763-783 Wallgrove Road.

Calculation of the road traffic noise contribution has been undertaken using the Calculation of Road Traffic Noise (CoRTN) algorithm within SoundPLAN. The CoRTN algorithm was utilised to predict the contribution from site road traffic at the nearest residential receivers during the day and night time periods.

From the Transport Assessment Report by Ason Group, 328 traffic movements in and out of the warehouse are predicted per day (light and heavy vehicles combined). 115 truck movements in and out of the masonry plant are predicted per day. A total of 220 truck movements per day and 60 per night have been considered in this assessment. At the end of Old Wallgrove Road, 90% of vehicle movements are assumed to be northbound towards the Great Western Highway or onto the M7. 10% of vehicle movements are assumed to be southwards on Wallgrove Road past the receiver at 763-783 Wallgrove Road. Vehicles are assumed to travel at the posted speeds of 70 km/h.

The $L_{Aeq,\ 15\ hour}$ and $L_{Aeq,\ 9\ hour}$ noise descriptors have been calculated at the most affected residential receptor along Wallgrove Road. The predicted noise levels are displayed in Table 7-1.

Table 7-1: Predicted Noise Levels Associated with Road Traffic, dB(A)

Receptor	Period	PSNL $L_{eq,15\ or\ 9\ hour}$	Predicted Additional Road Traffic Noise
763-783 Wallgrove Road	Day	60	42 ✓
	Night	55	38 ✓

For residential dwellings that front onto Wallgrove Road, the predicted noise levels associated with the vehicle movements from the site would be below the daytime criteria of $L_{Aeq\ (15\ hour)}$ 60 dBA and $L_{Aeq\ (9\ hour)}$ 55 dBA for arterial roads. Furthermore, given the current volumes along Wallgrove Road, the proposal will not increase the cumulative road traffic noise levels during the day or night periods.

Step 3 of Section 3.4.1 of the RNP identifies possible reasonable and feasible control measures when exceedances of either of the outlined criteria. As no exceedances are predicted, the proposed vehicle movements comply with the RNP, and no additional mitigation strategies are recommended.

8. CONSTRUCTION NOISE IMPACT ASSESSMENT

8.1 CONSTRUCTION ACTIVITIES

Construction activities are proposed to include the following:

- Establishment of site, fencing and compounds;
- Excavation/cut and fill levelling of land;
- Concreting site works;
- Construction of industrial buildings;
- Civil works, proposed road; and
- Asphalting works, proposed road.

8.2 MODELLED NOISE GENERATING SCENARIOS

Considering the construction activities outlined in Section 8.1, the construction scenarios listed in Table 8-1 are modelled for:

- Establishment of site, fencing and compounds (Scenario 1);
- Excavation/cut and fill levelling of land – warehouses (Scenario 2);
- Concreting site works – warehouses (Scenario 3);
- Construction of industrial buildings – warehouses (Scenario 4);
- Excavation/cut and fill levelling of land – masonry plant (Scenario 5);
- Concreting site works – masonry plant (Scenario 6);
- Construction of industrial buildings – masonry plant (Scenario 7);
- Civil works, proposed road (Scenario 8); and
- Asphalting works, proposed road (Scenario 9).

The noise generating scenarios consider a situation in which all equipment was running for 100% of the time over the 15 minute assessment period. The equipment list for the scenario is detailed in Table 8-1, with an equipment location diagrams in Figure 8-1 to Figure 8-9.

All works are proposed to be undertaken during standard construction hours, that is:

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

Table 8-1: Modelled Noise Scenarios for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
1. Establishment of site, fencing and compounds	Standard hours	• Generator • Hand tools • Truck
2. Excavation/cut and fill levelling of land – warehouses	Standard hours	• 5T excavator • Backhoe • Roller[1] • Dozer • Hand tools • Truck
3. Concreting site works – warehouses	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
4. Construction of industrial buildings – warehouses	Standard hours	• Truck • Crane • Hand Tools
5. Excavation/cut and fill levelling of land – masonry plant	Standard hours	• 5T excavator • Backhoe • Roller[1] • Dozer • Hand tools • Truck
6. Concreting site works – masonry plant	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
7. Construction of industrial buildings – masonry plant	Standard hours	• Truck • Crane • Hand Tools
8. Civil works, proposed road	Standard hours	• 5T excavator • Backhoe • Roller[1] • Dozer • Hand tools • Truck
9. Asphalting works, proposed road	Standard hours	• Grader • Asphalt paver[1] • Truck

Note 1: As per Section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

Figure 8-1: Construction Scenario 1 – Establishment of site, fencing and compounds

Figure 8-2: Construction Scenario 2 – Excavation/cut and fill levelling of land – warehouses

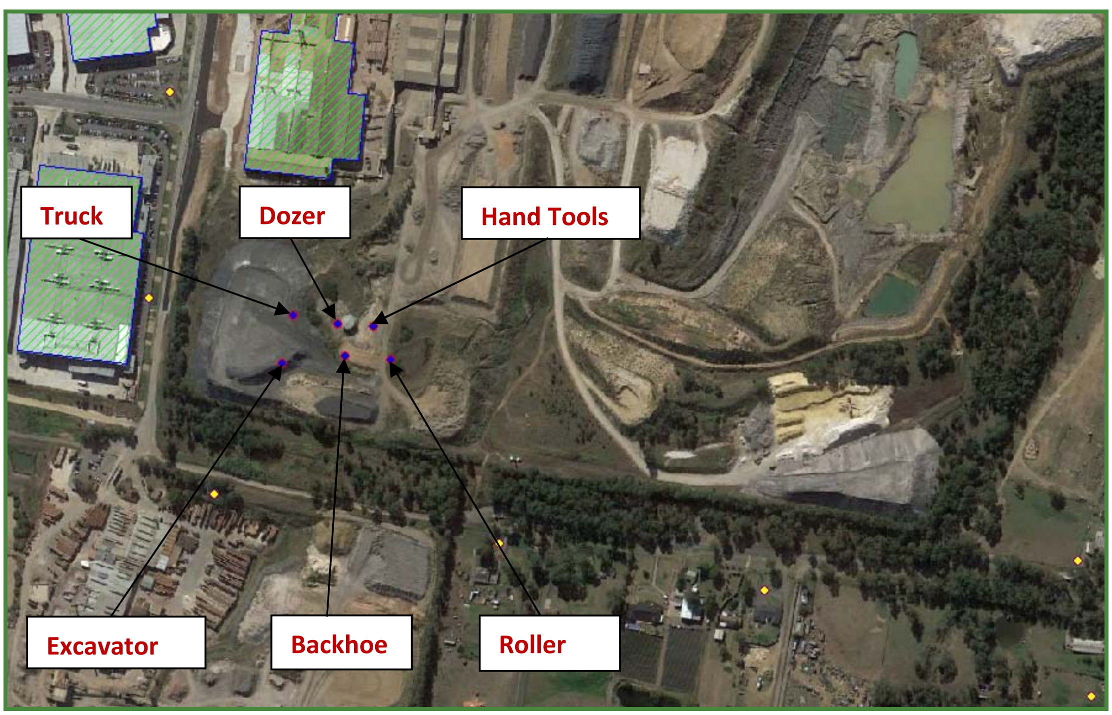


Figure 8-3: Construction Scenario 3 – Concreting site works – warehouses

Figure 8-4: Construction Scenario 4 – Construction of industrial buildings – warehouses

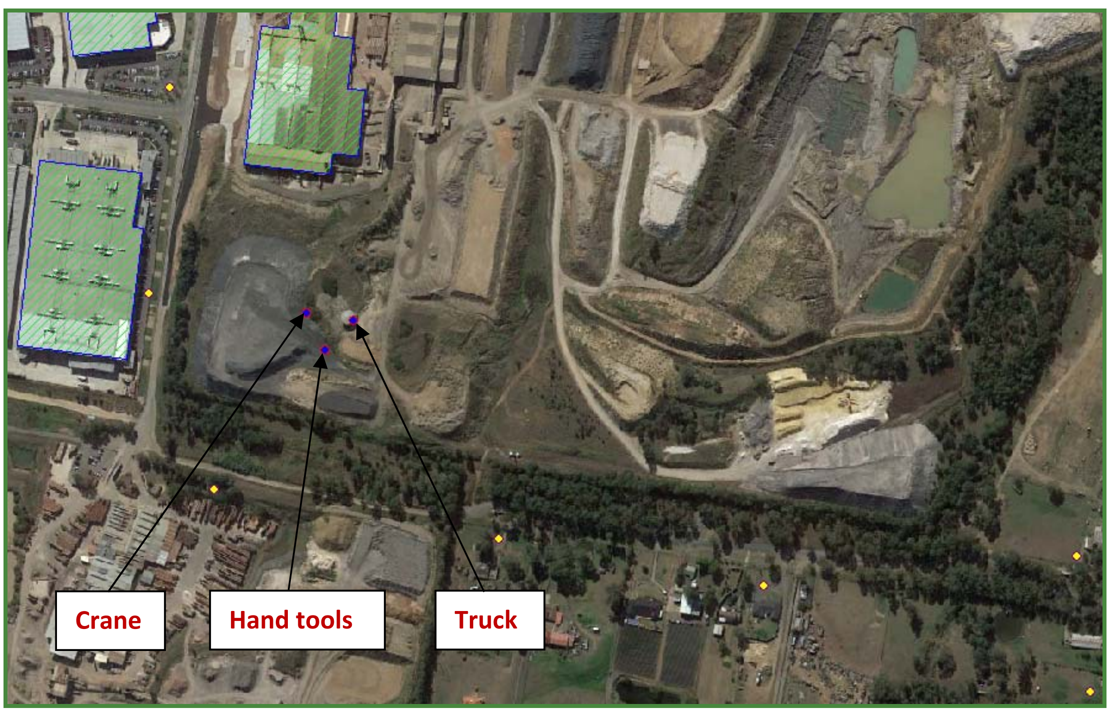


Figure 8-5: Construction Scenario 5 – Excavation/cut and fill levelling of land – masonry plant

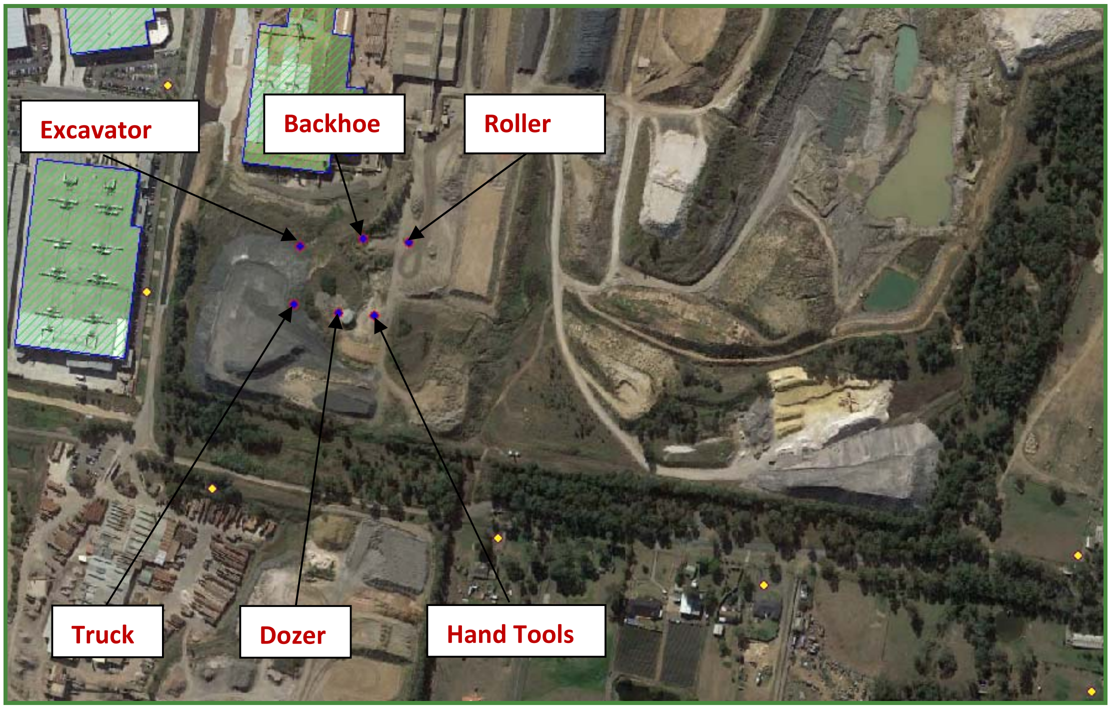


Figure 8-6: Construction Scenario 6 – Concreting site works – masonry plant

Figure 8-7: Construction Scenario 7 – Construction of industrial buildings – masonry plant

Figure 8-8: Construction Scenario 8 – Civil works, proposed road

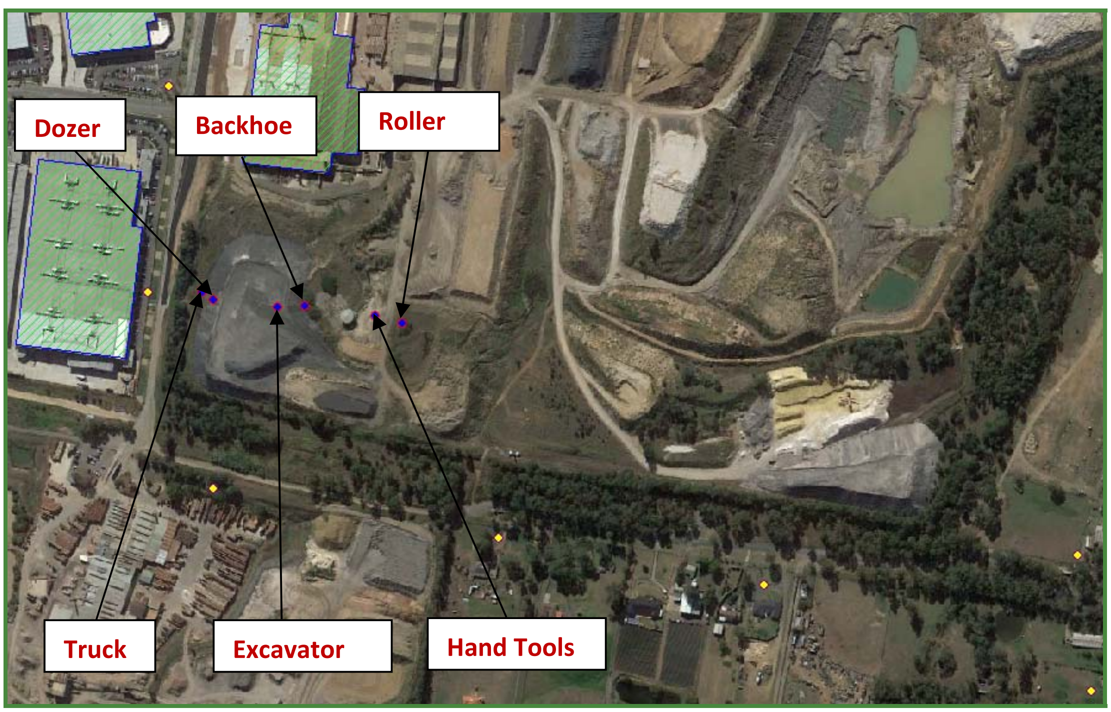


Figure 8-9: Construction Scenario 9 – Asphalting works, proposed road

8.3 Modelling Methodology

8.3.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the Concawe algorithm within SoundPLAN. The construction scenarios were modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

Assumptions made in the noise modelling of the construction noise scenarios are as follows:

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. Construction scenarios assume all equipment is running 100% of the time during the 15 minute assessment period, to provide a worst case scenario;
- Topographical information was obtained from Google Earth;
- All receptors were modelled at 1.5 m above ground level;
- All ground areas surrounding the subject site and the nearest nominated occupancies have been modelled considering different ground factors ranging from 0 to 1. The site and surrounding industrial areas have been modelled with a ground absorption factor of 0 (hard). The surrounding grasslands area has been modelled with a ground absorption factor of 1.0 (soft); and
- All noise sources associated with the construction works have been modelled as point sources.

8.3.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented shown in Table 8-2 below. The sound power levels for the relevant noise sources have been calculated from measurements of sound pressure levels undertaken by an acoustic engineer from Benbow Environmental at similar sites and sourced from Benbow Environmental's noise source database, as well as taken from AS 2436–2010 and the UK Department for Environmental Food and Rural Affairs (DEFRA) database, *Update of noise database for prediction of noise on construction and open sites*.

Table 8-2: A-weighted Sound Power Levels Associated with Construction Activities, dB(A)

Noise Source	Overall	Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Generator	**93**	79	84	83	85	87	86	83	69
Excavator 5T	**100**	80	83	89	95	94	93	90	83
Backhoe	**96**	76	78	83	89	91	89	88	77
Roller	**101**	81	86	96	96	94	91	82	72
Dozer	**108**	91	102	100	98	102	99	97	91
Hand tools	**100**	71	81	91	96	94	90	87	81
Truck	**105**	76	84	89	104	95	93	88	88
Concrete mixer truck	**104**	70	84	92	96	97	98	92	85
Concrete pump	**105**	77	92	97	99	100	95	95	89
Crane	**103**	84	84	87	94	98	97	95	85
Grader	**106**	82	91	94	96	104	99	95	84
Asphalt paver	**104**	80	89	91	97	99	98	91	83

8.4 Construction Predicted Noise Levels

Results of the predictive noise modelling of the construction activities are shown in Table 8-3. It can be seen that the predicted noise levels comply with the construction noise criteria at all residential receivers during standard construction hours.

Construction activities are therefore proposed to take place during standard **construction** hours as follows:

Monday to Friday: 7am to 5pm
Saturday: 8am to 1pm
Sunday and Public Holidays: No works permitted

Should construction works take place during standard construction hours, no additional noise mitigation measures are recommended.

Table 8-3: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	PSNL ($L_{eq,15 minute}$ dB(A))	Scenario (Standard Hours) (L_{eq}, dB(A))								
	Standard Hours	1	2[1]	3	4	5[1]	6	7	8[1]	9[1]
R1	45	24 ✓	39 ✓	30 ✓	27 ✓	39 ✓	29 ✓	27 ✓	36 ✓	33 ✓
R2	45	16 ✓	30 ✓	20 ✓	18 ✓	29 ✓	20 ✓	18 ✓	28 ✓	25 ✓
R3	45	25 ✓	32 ✓	24 ✓	23 ✓	33 ✓	22 ✓	22 ✓	34 ✓	32 ✓
R4	45	26 ✓	36 ✓	31 ✓	29 ✓	35 ✓	29 ✓	25 ✓	35 ✓	35 ✓
R5	45	22 ✓	32 ✓	24 ✓	23 ✓	32 ✓	24 ✓	23 ✓	31 ✓	30 ✓
R6	45	22 ✓	32 ✓	24 ✓	23 ✓	32 ✓	24 ✓	23 ✓	31 ✓	30 ✓
R7	45	24 ✓	31 ✓	20 ✓	22 ✓	33 ✓	27 ✓	25 ✓	33 ✓	30 ✓
R8	45	24 ✓	33 ✓	25 ✓	25 ✓	33 ✓	26 ✓	25 ✓	33 ✓	32 ✓
R9	45	16 ✓	27 ✓	17 ✓	16 ✓	27 ✓	17 ✓	17 ✓	27 ✓	24 ✓
R10	75	42 ✓	53 ✓	48 ✓	44 ✓	52 ✓	47 ✓	43 ✓	54 ✓	52 ✓
R11	75	47 ✓	55 ✓	48 ✓	44 ✓	53 ✓	48 ✓	44 ✓	68 ✓	62 ✓
R12	75	40 ✓	49 ✓	44 ✓	41 ✓	50 ✓	45 ✓	41 ✓	52 ✓	50 ✓
R13	75	25 ✓	35 ✓	28 ✓	26 ✓	35 ✓	29 ✓	26 ✓	34 ✓	34 ✓

✓Complies ✗ Non-compliance

Note 1: As per Section 4.5 of the Interim Construction Noise Guideline (DECC, 2009), a number of activities have proven to be particularly annoying to residents and have therefore had 5 dB added to their predicted levels.

9. VIBRATION IMPACT ASSESSMENT

In the NSW TfNSW Construction Noise Strategy document and Assessing Vibration – a Technical Guideline, equipment that may cause vibration impacts includes hydraulic hammers, vibratory pile drivers, pile boring, jackhammers, wacker packers, concrete vibrators and pavement breakers, amongst other equipment. The proposed construction activities may potentially include the use of vibratory rollers, while the operational activities are not proposed to include vibratory equipment.

9.1 CONSTRUCTION EQUIPMENT

The construction activities will not utilise equipment that generates significant vibration apart from the roller.

The recommended safe working distances from vibration intensive equipment is shown below. The criteria of the British Standard has been adopted, in line with the TfNSW Construction Noise and Vibration Guideline. No heritage buildings on site or from neighbouring properties are in the vicinity of the proposed construction activities, and therefore the criteria from the British Standard has been adopted.

The use of vibratory rollers have the potential to generate vibration. Human annoyance from vibration from construction equipment is considered more likely than structural damage to buildings.

Table 9-1: Recommended safe working distances for vibration intensive plant

Plant item	Rating/ description	Safe Working Distance	
		Cosmetic Damage[1]	Human Response[2]
Vibratory Roller	< 100 kN (Typically 2-4 Tonnes)	6 m	20 m
Vibratory Roller	< 200 kN (Typically 4-6 Tonnes)	12 m	40 m
Vibratory Roller	< 300 kN (Typically 7-13 Tonnes)	15 m	100 m
Vibratory Roller	< 300 kN (Typically 13-18 Tonnes)	20 m	100 m

Note 1: As per BS 7385
Note 2: As per OH&E Vibration Guideline

Vibratory rollers are planned to be used for excavation works. It is recommended that vibratory rollers are used at least 20 m from neighbouring buildings for a 13-18T roller, or otherwise utilise safe working distances in accordance with Table 9-1.

9.2 OPERATIONAL EQUIPMENT

The operational activities do not include equipment that generates significant vibration. No impacts on human or structures at neighbouring receivers are expected.

10. CONCLUDING REMARKS

Benbow Environmental has been engaged by Austral Bricks to prepare a noise impact assessment for a proposed masonry manufacturing plant and warehousing facility to be located at 224-398 Burley Road, Horsley Park. The principal noise sources associated with the site include noise from truck movements and forklifts associated with the warehouses and masonry plant. Noise will also be generated from the plant equipment and external crushing operations associated with the masonry plant.

The noise impact assessment was undertaken in accordance with the following guidelines:

- NSW Noise Policy for Industry (EPA, 2017);
- NSW Road Noise Policy (RNP) (DECCW, 2011);
- NSW Interim Construction Noise Guideline (DECC, 2009);
- Fairfield Citywide Development Control Plan (DCP) (Fairfield City Council, 2013); and
- British Standard BS 7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*'.

Assessment criteria for noise emissions from the subject site were used to determine whether the potential noise impacts from the site were within the derived limits or in exceedance of the guidelines.

The site operations, construction scenarios and road traffic impacts were modelled using the predictive noise software, Sound Plan. Operational noise modelling utilised a worst case scenario in which all activities were conducted simultaneously. The operational noise generating scenarios are predicted to comply with the project specific noise levels at all receivers during all time periods. Recommended operational noise control measures include broadband reversing alarms and minimisation of truck exhaust brakes on site.

Compliance with the guidelines set out in the NSW Road Noise Policy was predicted at all considered receptors.

During construction works, all activities were predicted to comply with the criteria outlined in the Interim Construction Noise Guideline. Construction activities are recommended to take place during standard construction hours.

No significant vibration impacts are expected during operational activities. During construction works, rollers are recommended to be utilised at least the minimum distances away from neighbouring structures, as per the TfNSW Construction Noise and Vibration Guideline and Table 9-1 of this document.

This concludes the report.

Victoria Hale	Peter Gangemi	R T Benbow
Environmental Scientist	Senior Acoustic Engineer	Principal Consultant

11. LIMITATIONS

Our services for this project are carried out in accordance with our current professional standards for site assessment investigations. No guarantees are either expressed or implied.

This report has been prepared solely for the use of Goodman Property Services, as per our agreement for providing environmental services. Only Goodman Property Services is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

Although all due care has been taken in the preparation of this study, no warranty is given, nor liability accepted (except that otherwise required by law) in relation to any of the information contained within this document. We accept no responsibility for the accuracy of any data or information provided to us by Goodman Property Services for the purposes of preparing this report.

Any opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal advice.

ATTACHMENTS

Attachment 1: Noise Terminology

‘A’ FREQUENCY WEIGHTING

The ‘A’ frequency weighting roughly approximates to the Fletcher-Munson 40 phon equal loudness contour. The human loudness perception at various frequencies and sound pressure levels is equated to the level of 40 dB at 1 kHz. The human ear is less sensitive to low frequency sound and very high frequency sound than midrange frequency sound (i.e. 500 Hz to 6 kHz). Humans are most sensitive to midrange frequency sounds, such as a child’s scream. Sound level meters have inbuilt frequency weighting networks that very roughly approximates the human loudness response at low sound levels. It should be noted that the human loudness response is not the same as the human annoyance response to sound. Here low frequency sounds can be more annoying than midrange frequency sounds even at very low loudness levels. The ‘A’ weighting is the most commonly used frequency weighting for occupational and environmental noise assessments. However, for environmental noise assessments, adjustments for the character of the sound will often be required.

AMBIENT NOISE

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc. Usually assessed as an energy average over a set time period ‘T’ (L_{Aeq},T).

AUDIBLE

Audible refers to a sound that can be heard. There are a range of audibility grades, varying from “barely audible”, “just audible” to “clearly audible” and “prominent”.

BACKGROUND NOISE LEVEL

Total silence does not exist in the natural or built-environments, only varying degrees of noise. The Background Noise Level is the minimum repeatable level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by all forms of traffic, industry, lawnmowers, wind in foliage, insects, animals, etc.. It is quantified by the noise level that is exceeded for 90 % of the measurement period ‘T’ (L_{A90}, T). Background Noise Levels are often determined for the day, evening and night time periods where relevant. This is done by statistically analysing the range of time period (typically 15 minute) measurements over multiple days (often 7 days). For a 15 minute measurement period the Background Noise Level is set at the quietest level that occurs at 1.5 minutes.

‘C’ FREQUENCY WEIGHTING

The ‘C’ frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

DECIBEL

The decibel (dB) is a logarithmic scale that allows a wide range of values to be compressed into a more comprehensible range, typically 0 dB to 120 dB. The decibel is ten times the logarithm of the ratio of any two quantities that relate to the flow of energy (i.e. power). When used in acoustics it is the ratio of square of the sound pressure level to a reference sound pressure level, the ratio of the sound power level to a reference sound power level, or the ratio of the sound intensity level to a reference sound intensity level. See also Sound Pressure Level and Sound Power Level. Noise levels in decibels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dB, and another similar machine is placed beside it, the level will increase to 53 dB (from $10 \log_{10} (10^{(50/10)} + 10^{(50/10)})$ and not 100 dB. In theory, ten similar machines placed side by side will increase the sound level by 10 dB, and one hundred machines increase the sound level by 20 dB. The human ear has a vast sound-sensitivity range of over a thousand billion to one so the logarithmic decibel scale is useful for acoustical assessments.

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

Many sounds, such as road traffic noise or construction noise, vary repeatedly in level over a period of time. More sophisticated sound level meters have an integrating/averaging electronic device inbuilt, which will display the energy time-average (equivalent continuous sound level - L_{Aeq}) of the 'A' frequency weighted sound pressure level. Because the decibel scale is a logarithmic ratio, the higher noise levels have far more sound energy, and therefore the LAeq level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

'F'(FAST) TIME WEIGHTING

Sound level meter design-goal time constant which is 0.125 seconds.

FLETCHER–MUNSON EQUAL LOUDNESS CONTOUR CURVES

The Fletcher–Munson curves are one of many sets of equal loudness contours for the human ear, determined experimentally by Harvey Fletcher and Wilden A. Munson, and reported in a 1933 paper entitled "Loudness, its definition, measurement and calculation" in the Journal of the Acoustic Society of America.

FREE FIELD

In acoustics a free field is a measurement area not subject to significant reflection of acoustical energy. A free field measurement is typically not closer than 3.5 metres to any large flat object (other than the ground) such as a fence or wall or inside an anechoic chamber.

FREQUENCY

The number of oscillations or cycles of a wave motion per unit time, the SI unit is the hertz (Hz). 1 Hz is equivalent to one cycle per second. 1000 Hz is 1 kHz.

IMPACT ISOLATION CLASS (IIC)

The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation. Not commonly used in Australia.

'I' (IMPULSE) TIME WEIGHTING

Sound level meter time constant now not in general use. The 'I' (impulse) time weighting is not suitable for rating impulsive sounds with respect to their loudness. It is also not suitable for assessing the risk of hearing impairment or for determining the 'impulsiveness' of a sound.

IMPACT SOUND INSULATION ($L_{nT,w}$)

Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured 1/3 octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE

An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

LOUDNESS

The volume to which a sound is audible to a listener is a subjective term referred to as loudness. Humans generally perceive an approximate doubling of loudness when the sound level increases by about 10 dB and an approximate halving of loudness when the sound level decreases by about 10 dB.

MAXIMUM NOISE LEVEL, LAFmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'F' (Fast) time weighting. Often used for noise assessments other than aircraft.

MAXIMUM NOISE LEVEL, LASmax

The root-mean-square (rms) maximum sound pressure level measured with sound level meter using the 'A' frequency weighting and the 'S' (Slow) time weighting. Often used for aircraft noise assessments.

NOISE RATING NUMBERS

A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the 'A' frequency weighted dB level minus five.

NOISE

Noise is unwanted, harmful or inharmonious (discordant) sound. Sound is wave motion within matter, be it gaseous, liquid or solid. Noise usually includes vibration as well as sound.

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

Reference: Dictionary of the NSW Protection of the Environment Operations Act (1997). "Offensive Noise means noise:
(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or
(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or
(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE

Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T60

The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α

Sound is absorbed in porous materials by the viscous conversion of sound energy to a small amount of heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2 kHz is termed the Noise Reduction Coefficient (NRC).

'S' (SLOW) TIME WEIGHTING

Sound level meter design-goal time constant which is 1 second.

SOUND ATTENUATION

A reduction of sound due to distance, enclosure or some other devise. If an enclosure is placed around a machine, or an attenuator (muffler or silencer) is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 20 dB reduces the sound energy by one hundred times.

SOUND EXPOSURE LEVEL (LAE)

Integration (summation) rather than an average of the sound energy over a set time period. Use to assess single noise events such as truck or train pass by or aircraft flyovers. The sound exposure level is related to the energy average (L_{Aeq}, T) by the formula L_{Aeq}, T = L_{AE} – 10 $\log_{10}$ T. The abbreviation (SEL) is sometimes inconsistently used in place of the symbol (L_{AE}).

SOUND PRESSURE

The rms sound pressure measured in pascals (Pa). A pascal is a unit equivalent to a newton per square metre (N/m^2).

SOUND PRESSURE LEVEL, Lp

The level of sound measured on a sound level meter and expressed in decibels (dB). Where L_P = 10 $\log_{10}$ $(Pa/Po)^2$ dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10^{-6} Pa) for airborne sound. L_p varies with distance from a noise source.

SOUND POWER

The rms sound power measured in watts (W). The watt is a unit defined as one joule per second. A measures the rate of energy flow, conversion or transfer.

SOUND POWER LEVEL, Lw

The sound power level of a noise source is the inherent noise of the device. Therefore sound power level does not vary with distance from the noise source or with a different acoustic environment. Lw = Lp + 10 $\log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

SOUND TRANSMISSION CLASS (STC)

An internationally standardised method of rating the sound transmission loss of partition walls to indicate the sound reduction from one side of a partition to the other in the frequency range of 125 Hz to 4000 kHz. (Refer: Australian Standard AS 1276 – 1979). Now not in general use in Australia see: weighted sound reduction index.

SOUND TRANSMISSION LOSS

The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS 1191 - 2002.

STATISTICAL NOISE LEVELS, Ln.

Noise which varies in level over a specific period of time 'T' (standard measurement times are 15 minute periods) may be quantified in terms of various statistical descriptors for example:-

- The noise level, in decibels, exceeded for 1 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF1}, T. This may be used for describing short-term noise levels such as could cause sleep arousal during the night.
- The noise level, in decibels, exceeded for 10 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF10}, T. In most countries the LAF10, T is measured over periods of 15 minutes, and is used to describe the average maximum noise level.
- The noise level, in decibels, exceeded for 90 % of the measurement time period, when 'A' frequency weighted and 'F' time weighted is reference to as L_{AF90}, T. In most countries the LAF90, T is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

STEADY NOISE

Noise, which varies in level by 6 dB or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1 1997).

WEIGHTED SOUND REDUCTION INDEX, Rw

This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 Hz to 3.150 kHz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999). Internal partition wall Rw + C ratings are frequency weighted to simulate insulation from human voice noise. The R_w + C is similar in value to the STC rating value. External walls, doors and windows may be R_w + C_{tr} rated to simulate insulation from road traffic noise. The spectrum adaptation term Ctr adjustment factor takes account of low frequency noise. The weighted sound reduction index is normally similar or slightly lower number than the STC rating value.

WHITE NOISE

White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

'Z' FREQUENCY WEIGHTING

The 'Z' (Zero) frequency weighting is 0 dB within the nominal 1/3 octave band frequency range centred on 10 Hz to 20 kHz. This is within the tolerance limits given in AS IEC 61672.1–2004: 'Electroacoustics - Sound level meters – Specifications'.

Attachment 2: Calibration Certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 20815 & FILT 4015

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052E	**Serial No:**	40814
Filter Type:	1/3 Octave	**Serial No:**	15335
Comments:	All tests passed for class 1. (See over for details)		
Owner:	Benbow Environmental 13 Daking Street North Parramatta NSW 2151		
Ambient Pressure:	1014 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	53% ±5%
Date of Calibration:	14/06/2017	**Issue Date:**	16/06/2017
Acu-Vib Test Procedure:	AVP10 (SLM) & AVP06 (Filters)		

CHECKED BY: .... **AUTHORISED SIGNATURE:** ....
Jack Kielt

Accredited for compliance with ISO/IEC 17025
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS

HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
web site: www.acu-vib.com.au

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 23100

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
13 Daking Street
North Parramatta NSW 2151

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.16	990.12	3.98
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1010 hPa ±1.5 hPa **Relative Humidity:** 31% ±5%
Temperature: 24 °C ±2° C
Date of Calibration: 11/07/2018 **Issue Date:** 11/07/2018
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: .... **AUTHORISED SIGNATURE:** ....
Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

NATA
WORLD RECOGNISED ACCREDITATION
Accredited Lab. 9262
Acoustic and Vibration Measurements

ACU-VIB ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

Acoustic Research Labs Pty Ltd | Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Certificate

Calibration Number C18129_Reissued

Client Details Benbow Environmental
13 Daking Street
North Paramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194593
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 23°C
Relative Humidity : 51.2%
Barometric Pressure : 100.57kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 9 Mar 2018
Secondary Check: Sandra Minto
Report Issue Date : 3 Oct 2018

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.21dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015Pa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.12dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 2 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

Attachment 3: QA/QC Procedures

Calibration of Sound Level Meters

A sound level meter requires regular calibration to ensure its measurement performance remains within specification. Benbow Environmental sound level meters are calibrated by a National Association of Testing Authority (NATA) registered laboratory or a laboratory approved by the NSW Environment Protection Authority (EPA) every two years and after each major repair, in accordance with AS 1259–1990.

The calibration of the sound level meter was checked immediately before and after each series of measurements using an acoustic calibrator. The acoustic calibrator provides a known sound pressure level, which the meter indicates when the calibrator is activated while positioned on the meter microphone.

The sound level meters also incorporate an internal calibrator for use in setting up. This provides a check of the electrical calibration of the meter, but does not check the performance of the microphone. Acoustical calibration checks the entire instrument including the microphone. Calibration certificates for the instrument sets used have been included as Attachment 1.

Care and Maintenance of Sound Level Meters

Noise measuring equipment contains delicate components and therefore must be handled accordingly. The equipment is manufactured to comply with international and national standards and is checked periodically for compliance. The technical specifications for sound level meters used in Australia are defined in Australian Standard AS 1259–1990 "*Sound Level Meters"*.

The sound level meters and associated accessories are protected during storage, measurement and transportation against dirt, corrosion, rapid changes of temperature, humidity, rain, wind, vibration, electric and magnetic fields. Microphone cables and adaptors are always connected and disconnected with the power turned off. Batteries are removed (with the instrument turned off) if the instrument is not to be used for some time.

Investigation Procedures

All investigative procedures were conducted in accordance with AS 1055.1–1997 *Acoustics – Description and Measurement of Environmental Noise* Part 1: *General Procedures*.

The following information was recorded and kept for reference purposes:

- type of instrumentation used and measurement procedure conducted;
- description of the time aspect of the measurements, ie. measurement time intervals; and
- positions of measurements and the time and date were noted.

As per AS 1055.1–1997, all measurements were carried out at least 3.5 m from any reflecting structure other than the ground. The preferred measurement height of 1.2 m above the ground was utilised. A sketch of the area was made identifying positions of measurement and the approximate location of the noise source and distances in meters (approx.).

Unattended Noise Monitoring

NOISE MONITORING EQUIPMENT

ARL noise loggers type Ngara and EL-215 were used to conduct the long-term unattended noise monitoring. This equipment complies with Australian Standard 1259.2–1990 *Acoustics – Sound Level Meters* and is designated as a Type 1 and Type 2 instrument suitable for field use.

The measured data is processed statistically and stored in memory every 15 minutes. The equipment was calibrated prior and subsequent to the measurement period using a Rion NC-73 sound level calibrator. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 1.

METEOROLOGICAL CONSIDERATION DURING MONITORING

For the long-term attended monitoring, meteorological data for the relevant period were provided by the Bureau of Meteorology, which was considered representative of the site for throughout the monitoring period.

DESCRIPTORS & FILTERS USED FOR MONITORING

Noise levels are commonly measured using A-weighted filters and are usually described as dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to low frequency sound than it is to high frequency sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Noise environments can be described using various descriptors depending on characteristics of noise or purpose of assessments. For this survey the L_{A90} was used to analyse the monitoring results. The statistical descriptors L_{A90} measures the noise level exceeded for 90% of the sample measurement time, and is used to describe the “Background noise”. Background noise is the underlying level of noise present in the ambient noise, excluding extraneous noise or the noise source under investigation.

Measurement sample periods were fifteen minutes. The Noise -vs- Time graphs representing measured noise levels at the noise monitoring location are presented in Attachment 3.

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

The microphone was positioned at 1.5 metres above ground level and was fitted with a windsock. The instrument was calibrated using a Rion NC-73 sound level calibrator prior and subsequent to the measurement period to ensure the reliability and accuracy of the instrument sets. There were no significant variances observed in the reference signal between the pre-measurement and post-measurement calibrations. Instrument calibration certificates have also been included in Attachment 1.

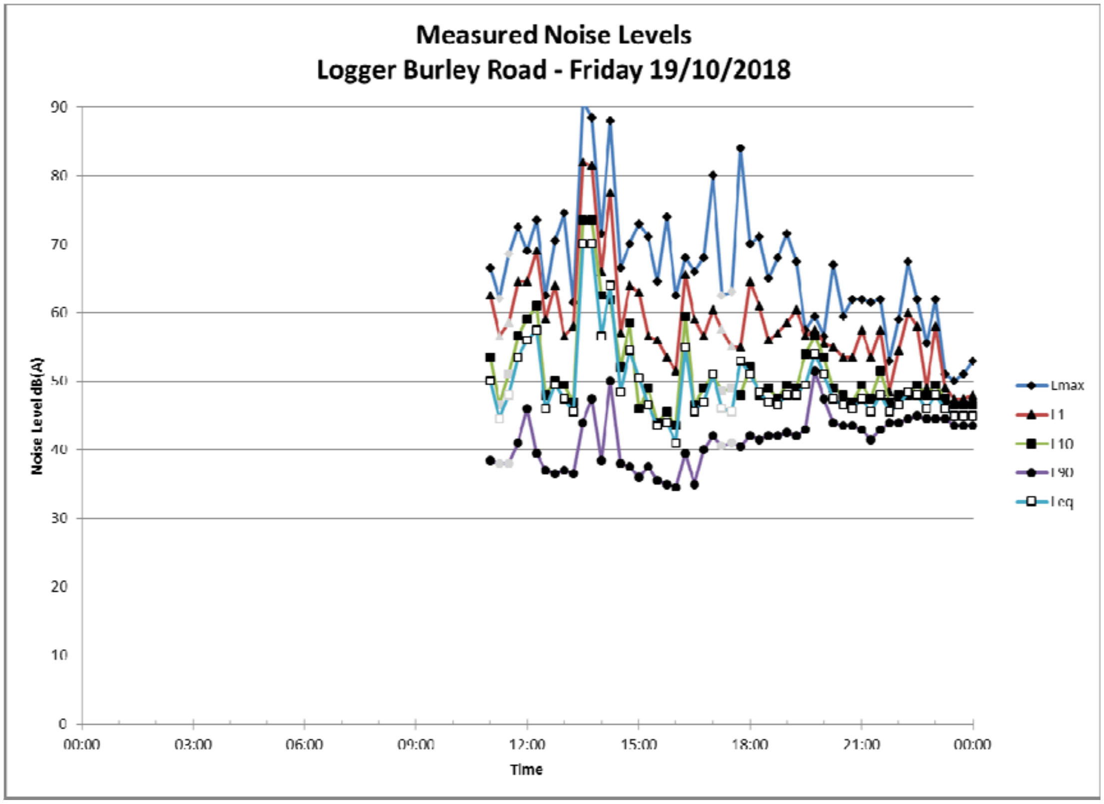
WEATHER CONDITIONS

It was partially cloudy, fine without significant breeze.

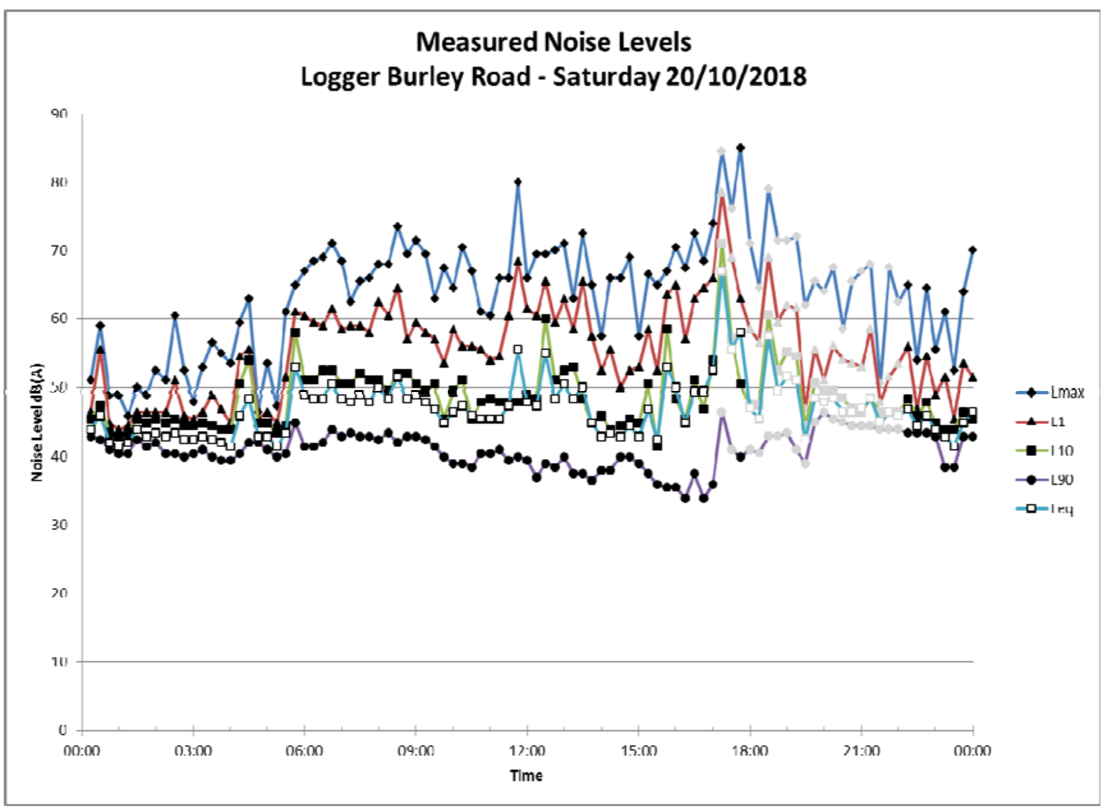
METHODOLOGY

The attended noise measurements were carried out generally in accordance with Australian Standard AS 1055-1997 "Acoustics – Description and Measurement of Environmental Noise".

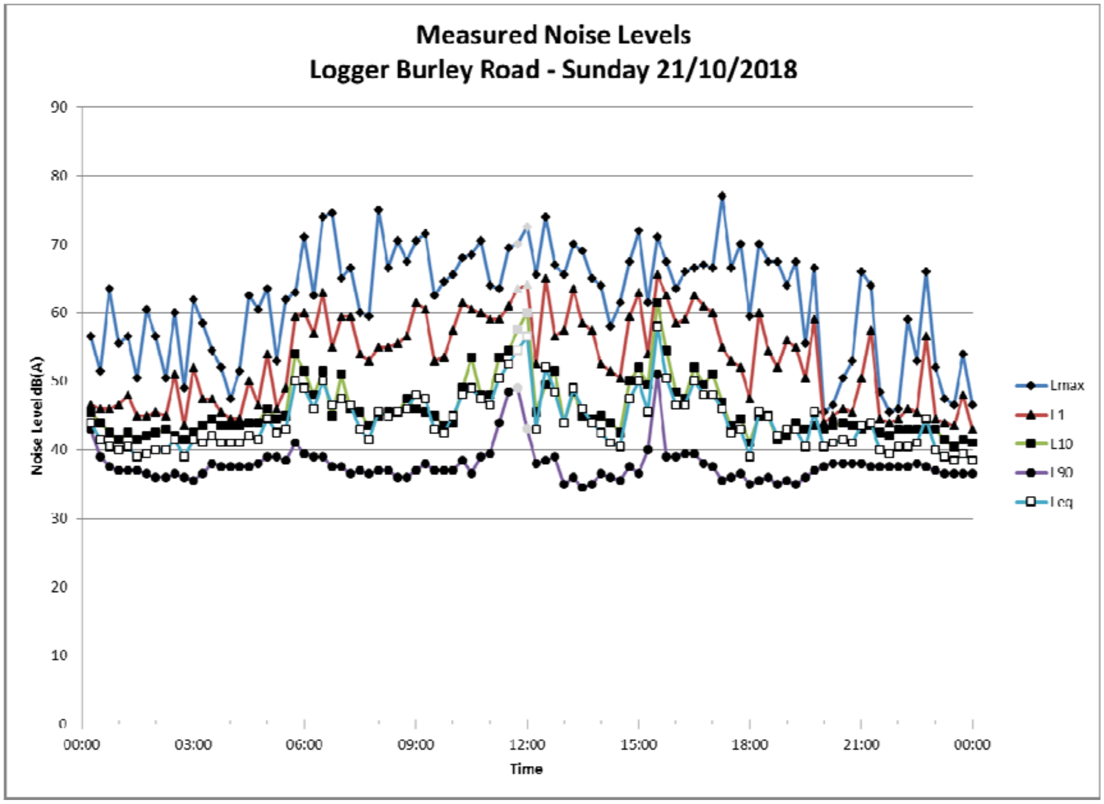
Attachment 4: Daily Noise Logger Charts

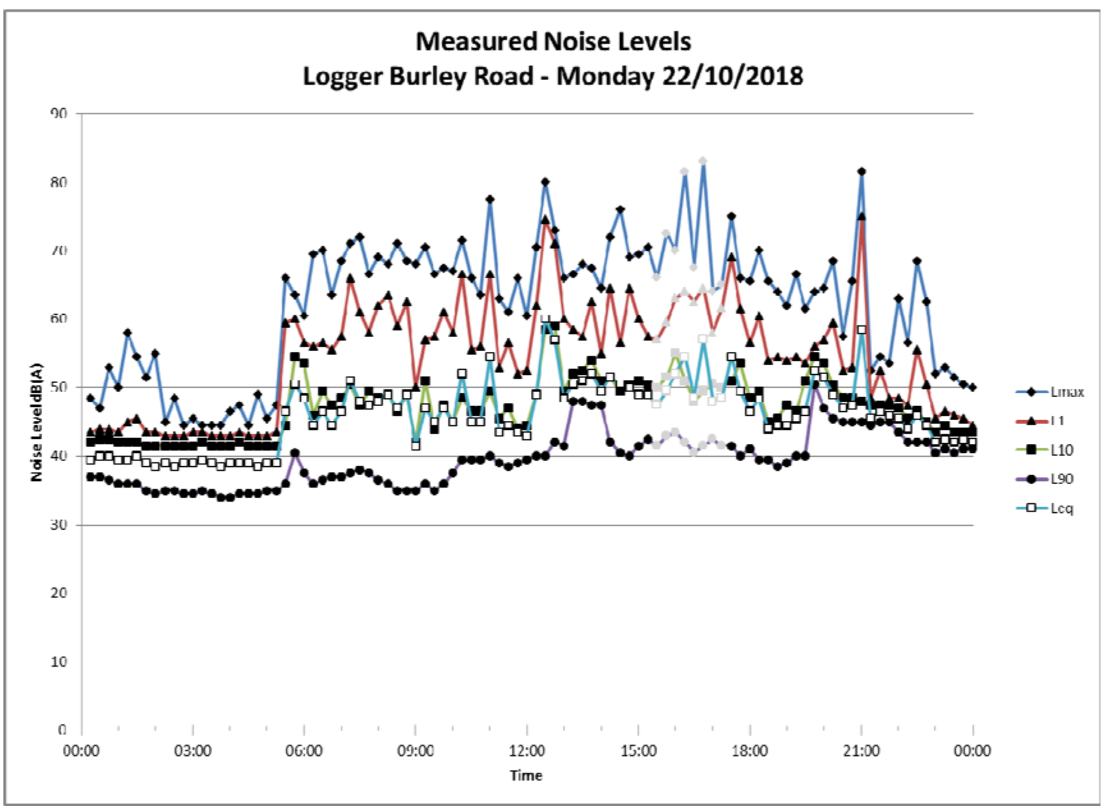


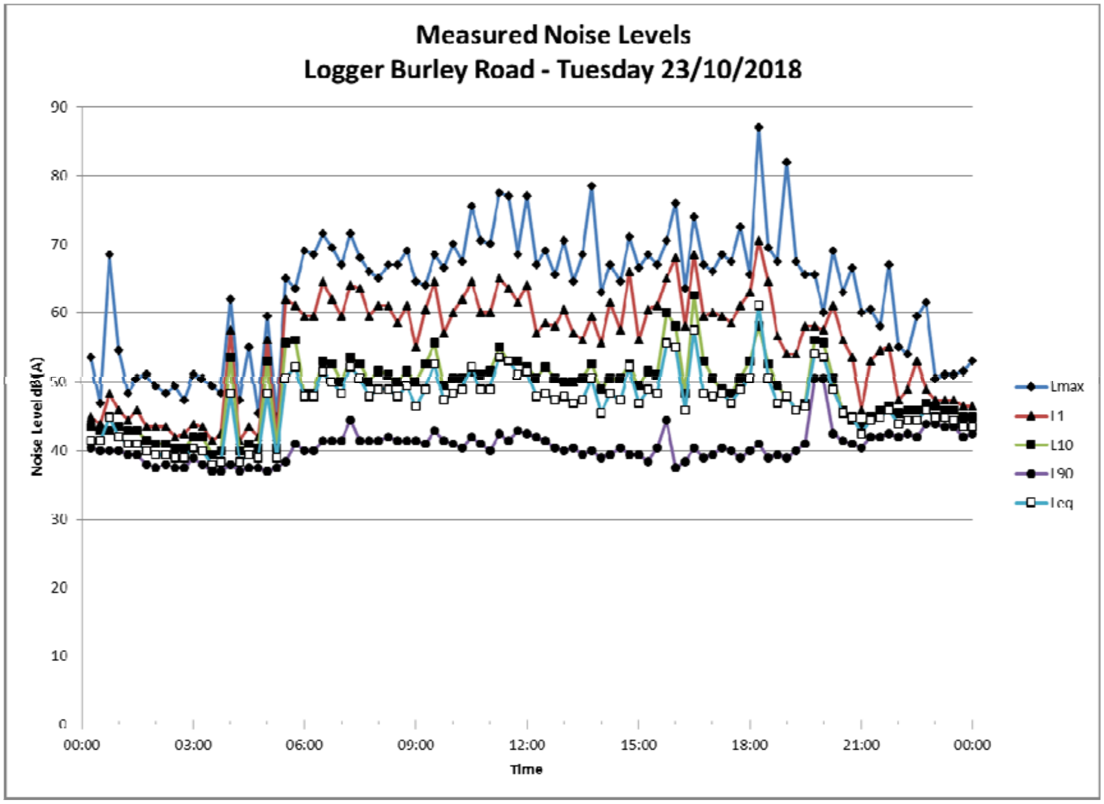
Measured Noise Levels
Logger Burley Road - Friday 19/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

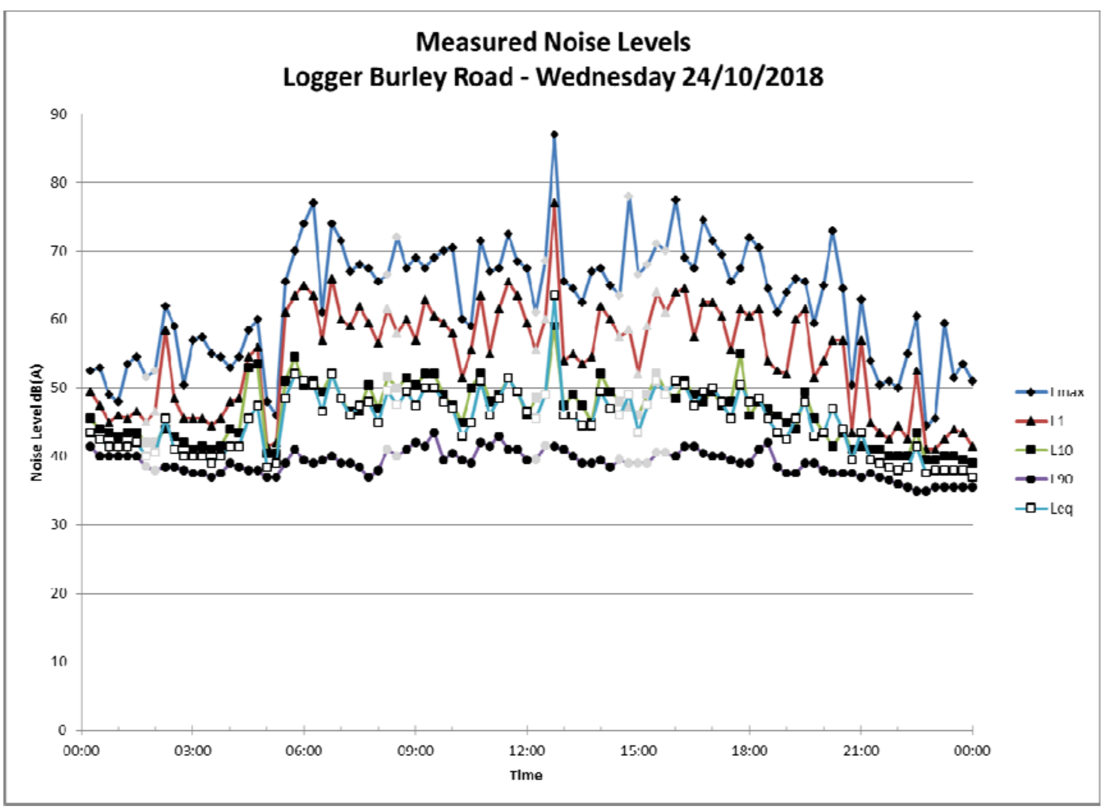


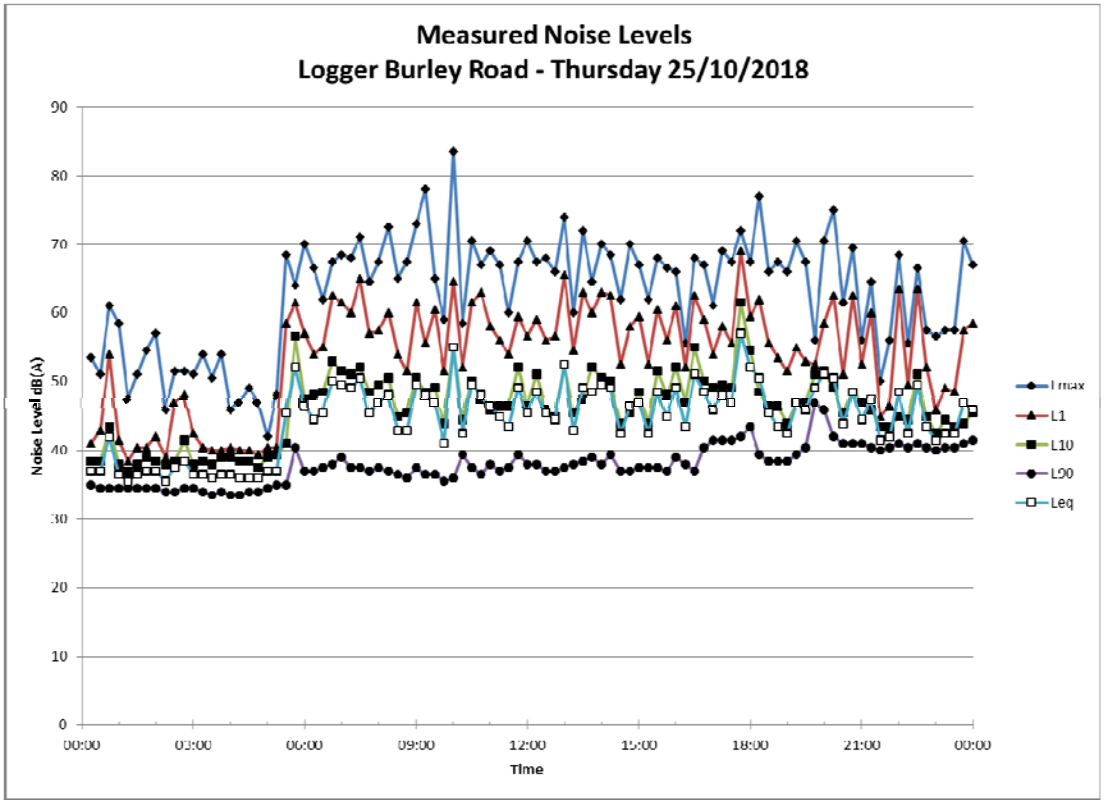
Measured Noise Levels
Logger Burley Road - Saturday 20/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

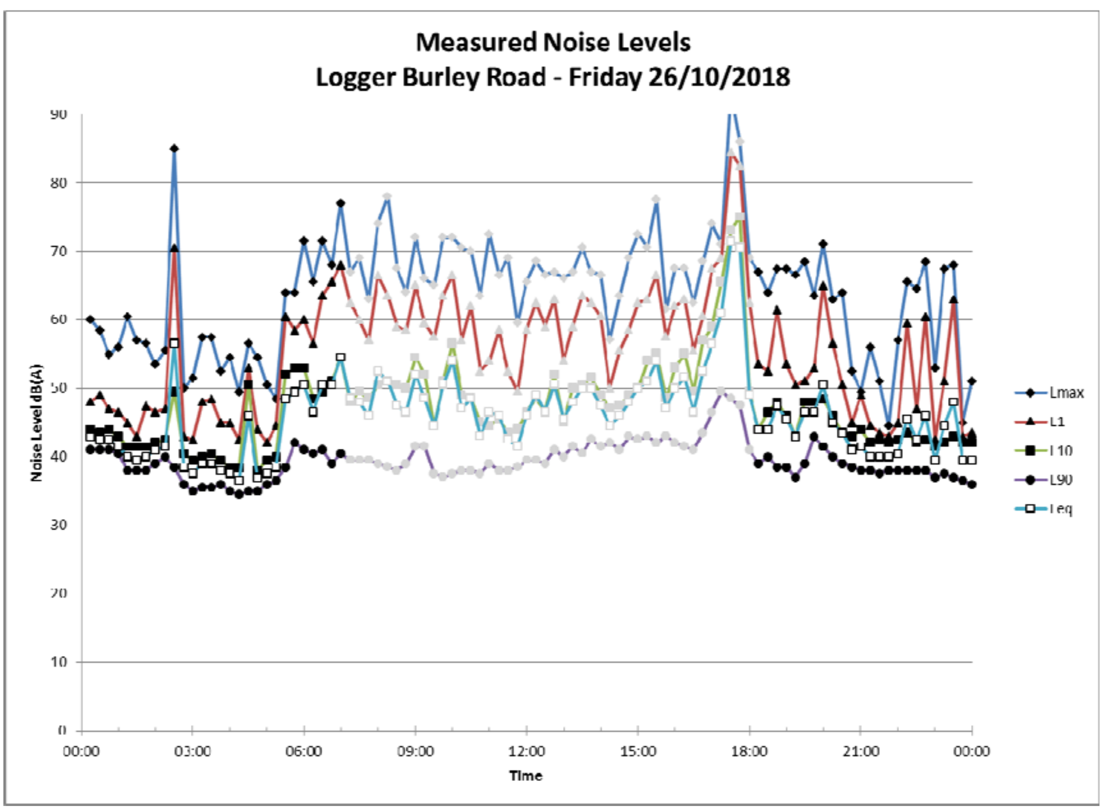

Measured Noise Levels
Logger Burley Road - Sunday 21/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

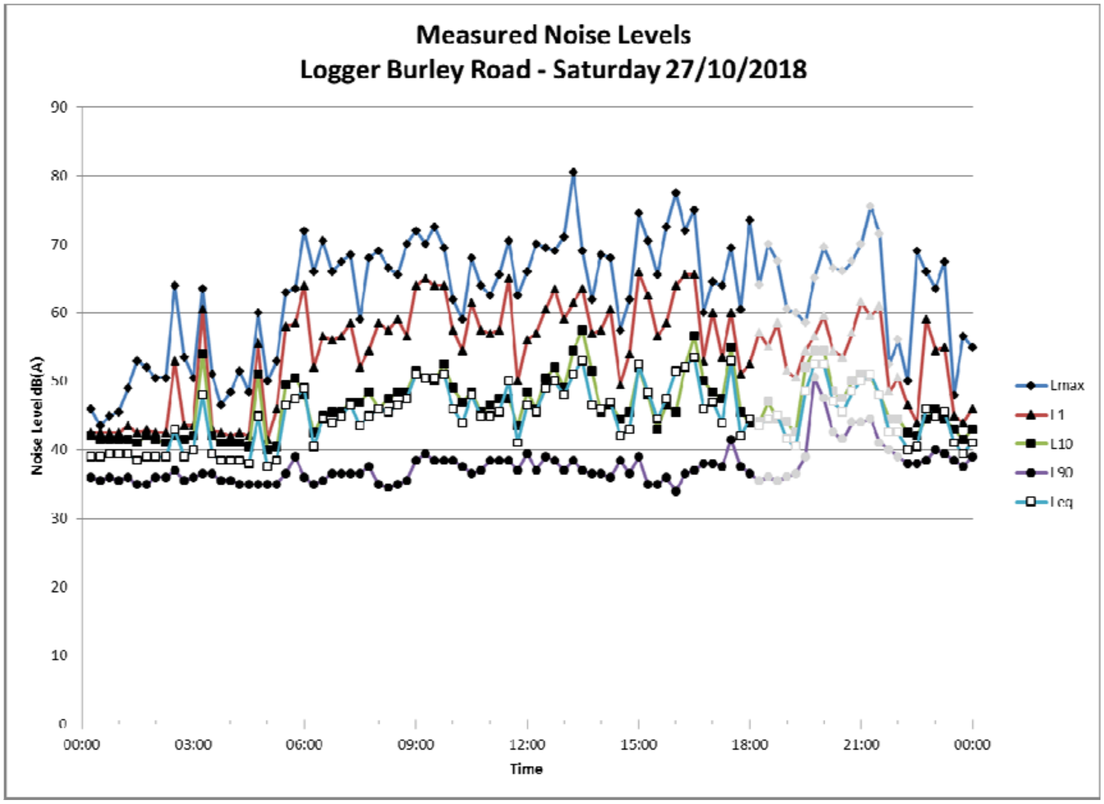

Measured Noise Levels
Logger Burley Road - Monday 22/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq

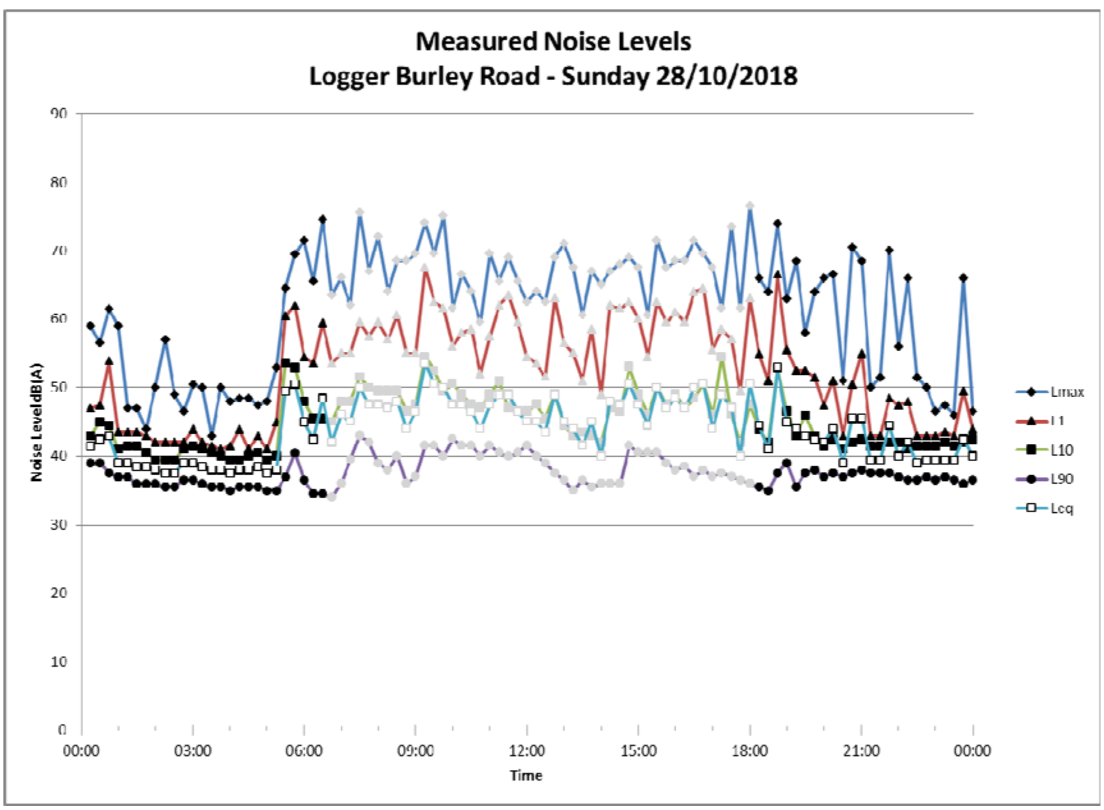

Measured Noise Levels
Logger Burley Road - Tuesday 23/10/2018
Noise Level dB(A)
Time
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq

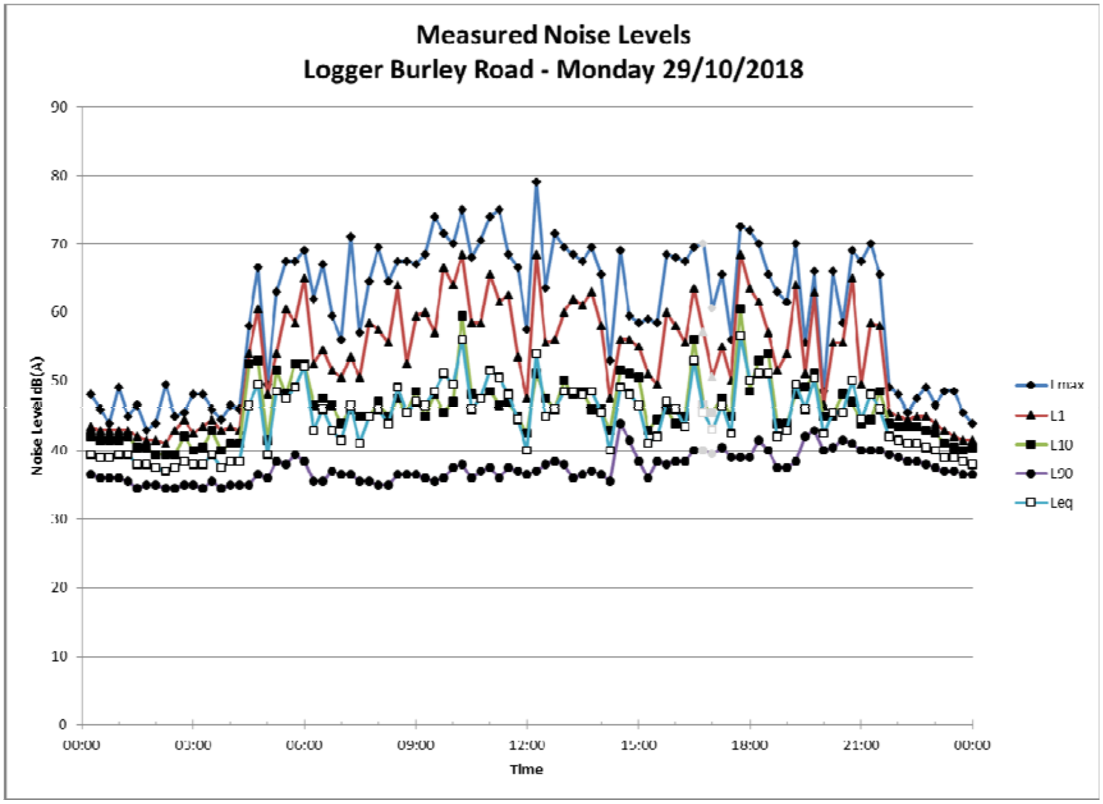

Measured Noise Levels
Logger Burley Road - Wednesday 24/10/2018
Noise Level dB(A)
Time
90
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq

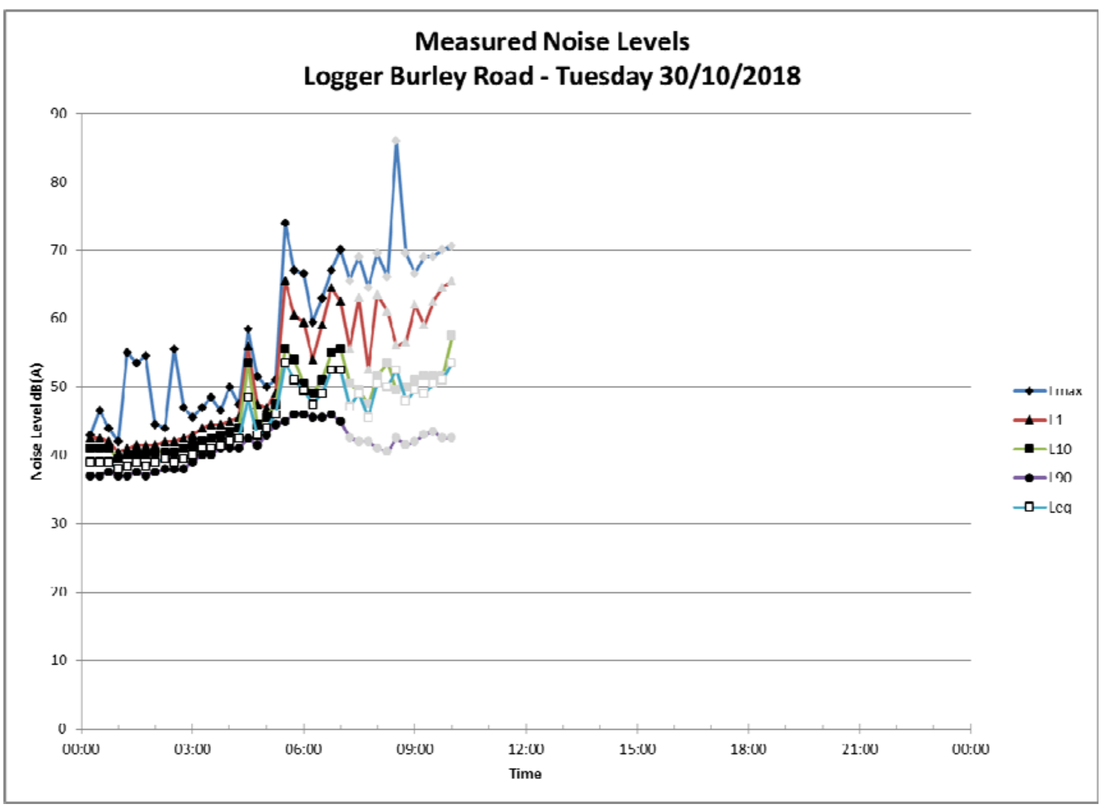

Measured Noise Levels
Logger Burley Road - Thursday 25/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Friday 26/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Saturday 27/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Sunday 28/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Monday 29/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Logger Burley Road - Tuesday 30/10/2018
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq