Attachment 3: Revised Noise Impact Assessment

NOISE IMPACT ASSESSMENT
FOR HALA ALAMEDDINE
99 SARGENTS ROAD, EBENEZER

Prepared for: Hala Alameddine, Hala Constructions Pty Ltd

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EXECUTIVE SUMMARY

This document presents a noise impact assessment conducted by Benbow Environmental for the proposed landscape material supplies and resource recovery facility located at 99 Sargents Road, Ebenezer. The site is proposed to process and store virgin excavated natural materials (VENM), excavated natural materials (ENM) and construction and demolition (C&D) materials. Annual throughput of 20,000 tonnes per year is sought.

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. Recommendations for noise controls are given in section 7.3, including operational hours and site management practices.

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

Compliance with the guidelines set out in the Interim Construction Noise Guideline was predicted at the vast majority of receivers. Recommended noise controls for construction works are listed in section 9.4.1.

This report concludes that following the carrying out of the recommendations in this report, the proposed site activities will comply with all considered noise criteria at all surrounding receptors.

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1. INTRODUCTION

Benbow Environmental has been engaged to undertake a noise impact assessment for the proposed landscape material supplies and resource recovery facility at 99 Sargents Road, Ebenezer.

The site is located within a RU1 Primary Production Zoning in Ebenezer, within Hawkesbury City Council. The nearest residential receptor is located adjacent to the southwest boundary of the site.

The site is proposed to house a landscaping supply and resource recovery facility using virgin excavated natural materials (VENM), excavated natural materials (ENM) and construction and demolition (C&D) materials. The materials will be sourced from excavations on sites where Hala Constructions operate, but will also be sourced from other sites. Screening and crushing of some of the materials is proposed to occur inside a shed on site.

Noise emissions from the site were predicted by using noise modelling software, SoundPlan.

This noise impact assessment has been prepared in accordance with the following guidelines and documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry 2017;
- Department of Environment, Climate Change and Water (DECCW) NSW, Road Noise Policy (RNP) 2011; and
- Department of Environment and Climate Change (DECC) NSW, Interim Construction Noise Guideline (ICNG) 2009.

1.1 SCOPE OF WORKS

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

- Site inspection and review of the proposed site operations;
- Short term attended noise measurements in accordance with relevant guidelines;
- Establish project specific noise levels;
- Determine all potential noise sources associated with the existing and proposed development;
- Collect required noise sources data;
- Predict potential noise impacts at the nearest potentially affected receptors to the site;
- Assess potential noise impacts against relevant legislation and guidelines;
- Recommend general ameliorative measures/control solutions (where required); and
- Compile this report with concise statements of potential noise impact.

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

2. PROPOSED DEVELOPMENT

2.1 OVERVIEW OF OPERATIONS

The proponent is seeking to establish a landscape material supplies business and resource recovery facility at 99 Sargents Road, Lot 288 DP 751665, Ebenezer.

The site is proposed to house a landscaping supply and resource recovery facility using virgin excavated natural materials (VENM), excavated natural materials (ENM) and C&D materials. The materials will be sourced from excavations on sites where Hala Constructions operate, but will also be sourced from other sites. Screening and crushing of some of the materials is proposed to occur inside a shed on site. An existing dwelling will be used for offices.

Trucks will enter the site from Sargents Road via a separate driveway and unload materials into the processing shed. Materials will be screened, crushed and sorted. Material will be transferred by front end loader to stockpiles on site. Materials will then be stored in stockpiles, or transferred out to market.

The stationary noise sources, including the screen and crusher are located inside the building. Mobile equipment such as trucks, the excavator and front end loader may be located inside or outside the building. Truck movements per day include up to 10 truck trips, or a maximum of 2 truck trips per hour.

2.2 HOURS OF OPERATIONS

The landscape facility is proposed to operate from Monday to Friday 7am to 6pm and Saturday from 8am to 4pm. The site is not proposed to operate on Sundays or Public Holidays.

2.3 DESCRIPTION OF THE PROPOSAL

2.3.1 Site Description

The proposal site is located at 99 Sargents Road, Ebenezer and is 15,000 m^2 (15 hectares) in size. Two dwellings and a number of sheds are located on the property. The land and surrounds are zoned RU1 Primary Production in the Hawkesbury City Council Local Environment Plan 2012.

Unloading and processing is proposed to occur in the main shed located in the centre of the site. Trucks are proposed to enter and exit the site from Sargents Road.

A site layout plan of the proposed development within the 99 Sargents Road property is shown in Figure 2-1 and a shed layout shown in Figure 2-2.

Figure 2-1: Site Layout

REV	DESCRIPTION	DATE	BY
A	CONCEPT PLANS	01/03/19	CB
B	ISSUED FOR DA	07/08/19	CB

FOR DA APPROVAL

bainidesign

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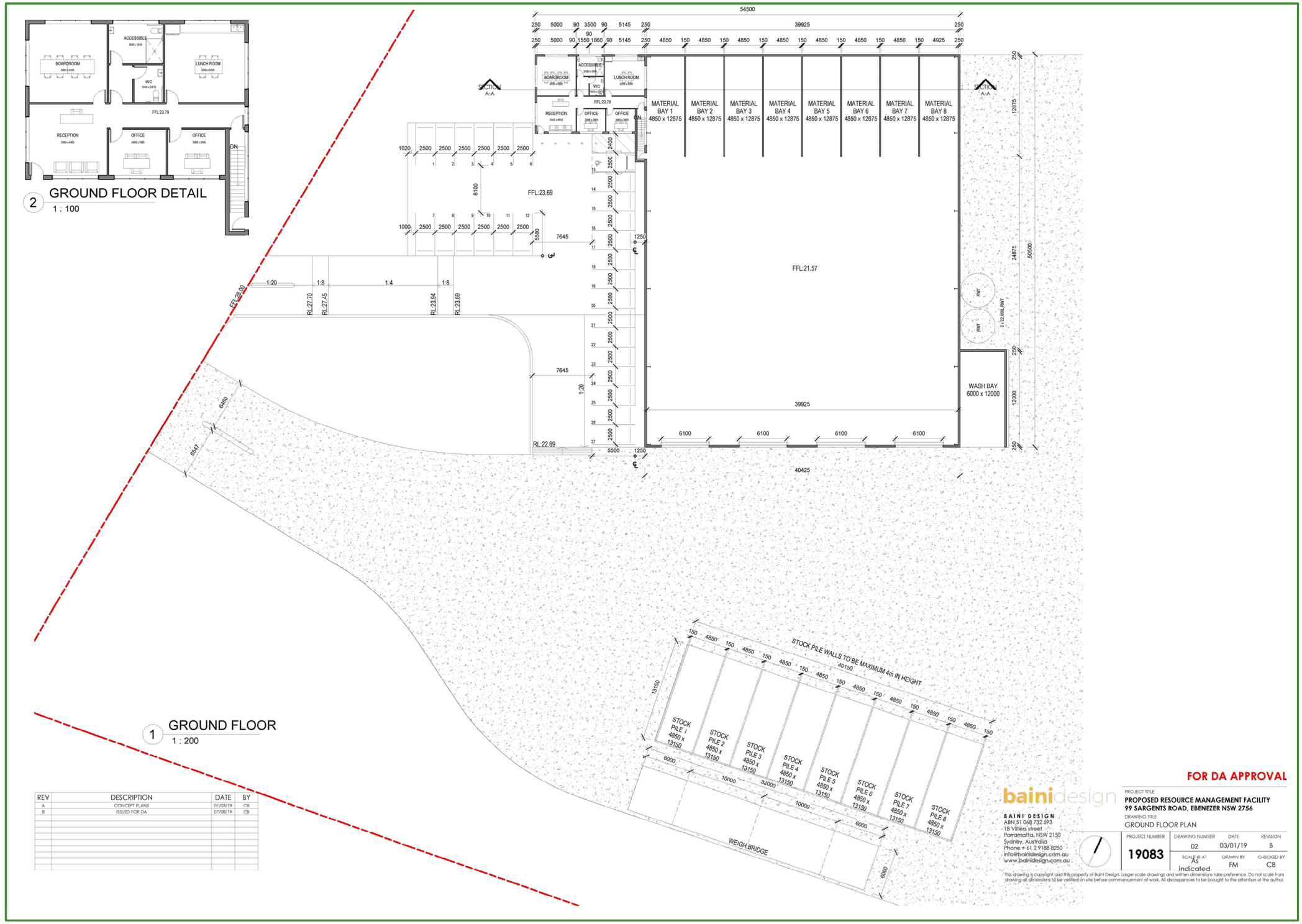
PROJECT TITLE
PROPOSED RESOURCE MANAGEMENT FACILITY
99 SARGENTS ROAD, EBENEZER NSW 2756
DRAWING TITLE
SITE PLAN

PROJECT NUMBER	DRAWING NUMBER	DATE	REVISION
19083	01	06/07/17	B
	SCALE @ A1	DRAWN BY	CHECKED BY
	1 : 300	FM	CB

Figure 2-2: Shed Layout



REV	DESCRIPTION	DATE	BY
A	CONCEPT PLANS	01/03/19	CB
B	ISSUED FOR DA	07/08/19	CB

2.3.2 Process Description

The processes involved in the sorting operations are as follows:

- Trucks drive to the site with virgin excavated natural materials (VENM), excavated natural materials (ENM) and C&D materials from sites, entering the property from Sargents Road.
- Trucks arrive on site at a rate of 4-5 per day (4-5 truck movements entering the site and 4-5 truck movements exiting the site).
- Trucks drive into the unloading and processing shed and unload materials in the holding area.
- Materials are crushed, screened and separated.
- Sorted materials are loaded to stockpiles using the front end loader. Sorted materials are stored in designated bays include bricks, concrete, timber, glass and metal.
- The bunkers and stockpiles are external to the shed.
- Products are either exported from site by truck, sold on location, or stored on site.

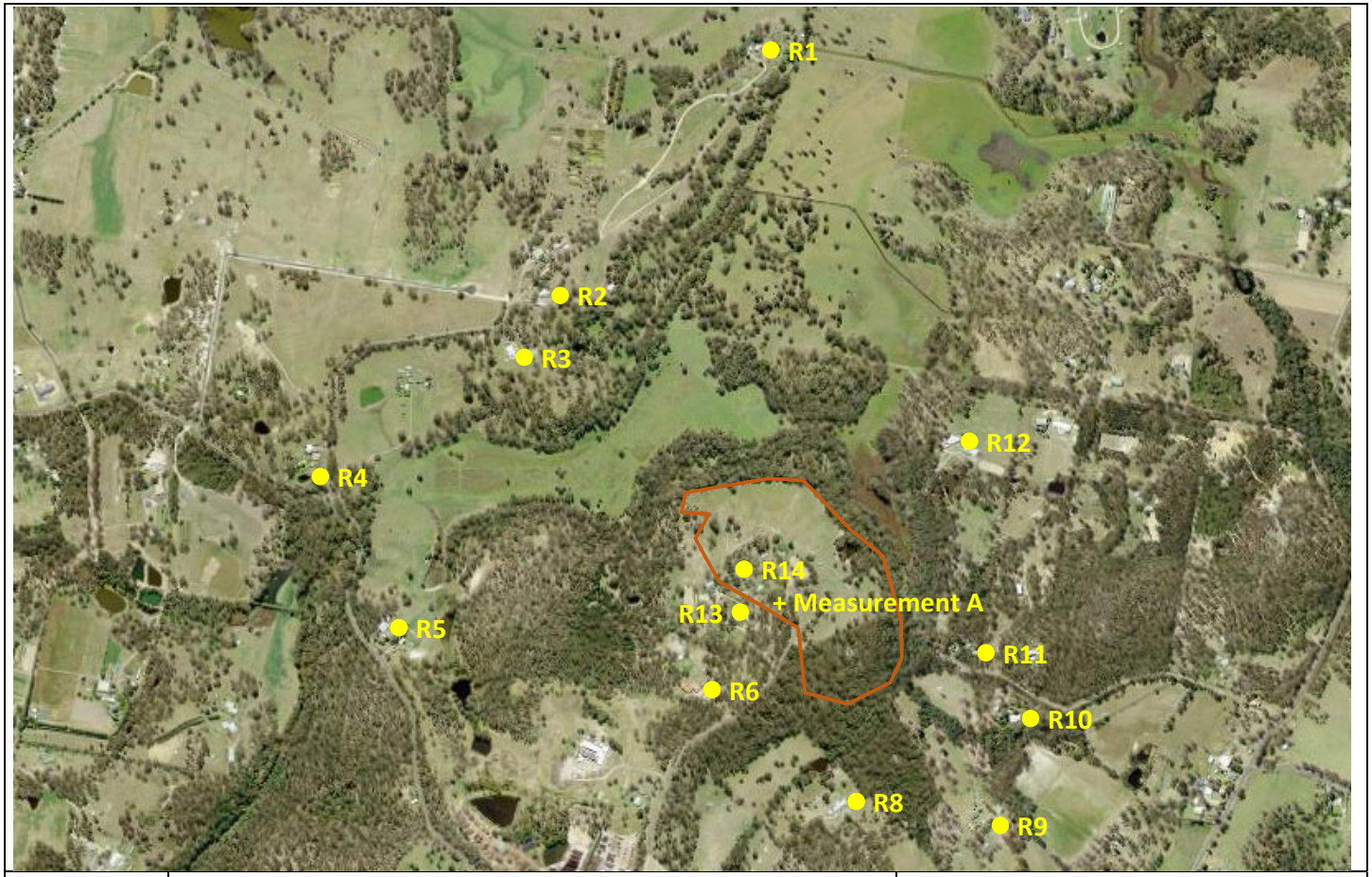
3. NEAREST SENSITIVE RECEPTORS

Table 3-1 identifies the nearest sensitive receptors that have the potential to be affected by the proposal. The aerial photographs of the sensitive receivers are shown in Figure 3-1. These receptors were selected based on their proximity and directional bearing from the subject site.

Table 3-1: Nearest Receivers

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Development	Type of Receptor
R1	103 Stannix Park Lane, Wilberforce	Lot 111 DP 1171265	1270 m N	Residential
R2	82 Stannix Park Lane, Wilberforce	Lot 112 DP 1171265	920 m NW	Residential
R3	60 Stannix Park Lane, Wilberforce	Lot 2153 DP 1073493	880 m NW	Residential
R4	235 Stannix Park Road, Wilberforce	Lot 2 DP 48682	1220 m W	Residential
R5	283 Stannix Park Road, Wilberforce	Lot 1 DP 847274	1000 m W	Residential
R6	71 Sargents Road, Ebenezer	Lot 91 DP 1049276	340 m SW	Residential
R7	79 Sargents Road, Ebenezer	Lot 92 DP 1049276	Adjacent 235 m W	Residential
R8	56 Sargents Road, Ebenezer	Lot 100 DP 1044703	470 m S	Residential
R9	89 Kolora Road, Ebenezer	Lot 4 DP 253783	625 m SE	Residential
R10	65 Kolora Road, Ebenezer	Lot 3 DP 253783	470 m SE	Residential
R11	88 Kolora Road, Ebenezer	Lot 2 DP 557365	360 m SE	Residential
R12	96 Kolora Road, Ebenezer	Lot 1 DP 557365	455 m NE	Residential
R13	79 Sargents Road, Ebenezer	Lot 92 DP 1049276	Adjacent 170 m W	Residential
R14	99 Sargents Road, Ebenezer	Lot 288 DP751665	Onsite 150 m NW	Residential

Figure 3-1: Nearby Receptors



4. EXISTING ACOUSTIC ENVIRONMENT

The level of background and ambient noise is assessed separately for the daytime, evening and night time assessment periods. The NSW EPA Noise Policy for Industry defines these periods as follows:

- **Day** is defined as 7.00am to 6.00pm, Monday to Saturday and 8.00am to 6.00pm Sundays and Public Holidays;
- **Evening** is defined as 6.00pm to 10.00pm, Monday to Sunday and Public Holidays; and
- **Night** is defined as 10.00pm to 7.00am, Monday to Saturday and 10.00pm to 8.00am Sundays and Public Holidays.

An attended noise measurement was conducted on the 18th of October at one (1) residential location.

4.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

The attended noise level measurement was carried out using a Svantek SVAN 957 Precision Sound Level Meter. The instrument set complied with AS IEC 61672.1–2004 and was calibrated by a NATA accredited laboratory within two years of the measurement period. Calibration certificates have been included in Attachment 2.

Measurements of ambient noise levels were carried out in accordance with the Australian Standard AS 1055–1997 *Acoustics – Description and measurements of environmental noise* – Part 1 and Part 2 and the Noise Policy for Industry (EPA, 2017).

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 instrument was set on A-weighted Fast response and noise levels were measured over a 15-minute statistical interval. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in Attachment 3. The microphone was fitted with a windsock and was positioned between 1.2 and 1.5 metres above ground level.

Details of the instrumentation and setting utilised are provided in Table 4-1.

Table 4-1: Instrumentation and Setup Details

Type of Monitoring	Equipment	Serial Number	Setup Details
Short-term Attended	Svantek SVAN957 Type 1 Integrating Sound and Vibration analyser	15335	Three channels: A-weighted Fast Response C-weighted Fast Response A-weighted Impulse Response 15 minute integration period 1/3 octave band recorded every 100 ms Logger file Recorded at steps of 100 ms

4.2 MEASUREMENT LOCATIONS

An attended noise measurement was undertaken on the 18th October 2018 at one (1) residential location. The measurement location is shown in Figure 3-1 and listed in Table 4-2.

Table 4-2: Noise Monitoring Locations

Monitoring Location	Methodology	Address
A	Attended monitoring	99 Sargents Road, Ebenezer

4.3 MEASURED NOISE LEVELS

4.3.1 Short Term Operator Attended Noise Monitoring Results

Attended noise monitoring was conducted on Thursday the 18th of October 2018 in order to gain an understanding of the background noise sources of the area. Noise contributions were obtained from ambient noise sources such as local fauna, road traffic and industrial sources. The results of the short-term attended noise monitoring are displayed in Table 4-3.

The attended measurements showed that the background noise levels were dominated by constant bird chirping from surrounding bushland. Ambient noise levels consisted of dogs, aeroplanes, road traffic from nearby roads and residential noise from neighbouring sites. The background noise level was measured to be 34 dB(A).

Table 4-3: Operator Attended Noise Measurements, dB(A)

Location & Date/Time	L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	Comments
Location A Thursday 18/10/2018 9:32 Daytime Period	49	34	48	59	Car Sargents Road < 65 dB(A) Truck Air Brakes Sackville Ferry Road < 43 dB(A) Birds Chirping < 57 dB(A) Aeroplane < 48 dB(A) Dog < 48 dB(A) Trucks Stannix Park Road < 41 dB(A)

4.3.2 Long-Term Unattended Noise Monitoring Results

Based upon the site visit and the L_{A90} from the attended noise measurement, it was decided that any long term measurements on site would fall below the minimum rating background level (RBL) as per Table 2.1 of the Noise Policy for Industry. The minimum RBL is shown in Table 4-4 below.

Table 4-4: Unattended Noise Monitoring Results, dB(A)

Monitoring Location and associated receptors	Assessment Background Level ABL (L_{90})		
	Day	Evening	Night
Logger A	35[1]	30[1]	30[1]

Note 1: As per Table 2.1 of the Noise Policy for Industry, the minimum assumed background noise levels are 35 dB(A) for the day period, 30 dB(A) for the evening period and 30 dB(A) for the night period.

5. METEOROLOGICAL CONDITIONS

Wind and temperature inversions may affect the noise impact at the receptors. Therefore noise enhancing weather conditions should be assessed when wind and temperature inversions are considered to be a feature of the area.

A site-representative meteorological data file was obtained from the Bureau of Meteorology (BOM) for the Richmond RAAF Automatic Weather Station (AWS ID 067105). At the time of preparing this report, the last full year of data available is 2017, and was therefore considered appropriate.

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.

5.1.1 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.

5.1.2 Local Wind Trends

Seasonal wind rose plots for this site utilising Richmond RAAF AWS data have been included in Figure 5-1, Figure 5-2 and Figure 5-3 for day, evening and night periods respectively.

Figure 5-1: Wind Rose Plots – BOM Richmond RAAF AWS ID 067105 2017 – Day time

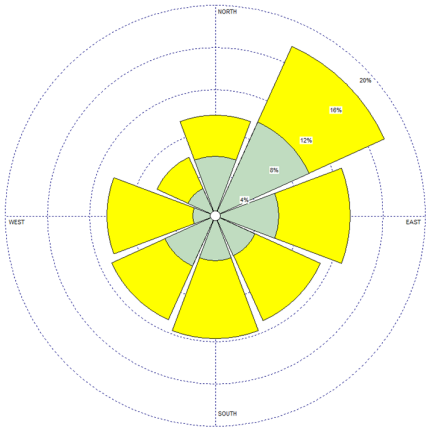
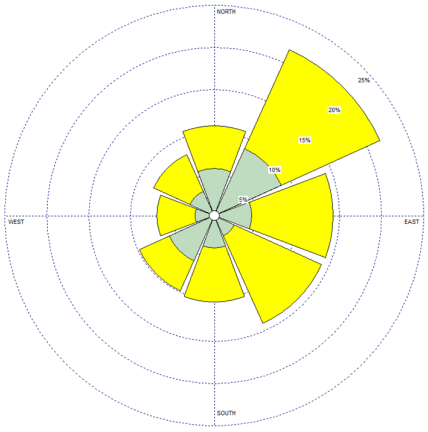
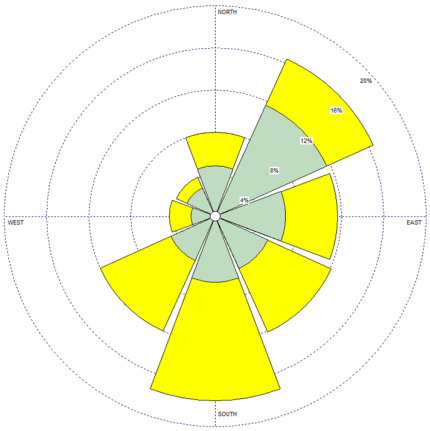
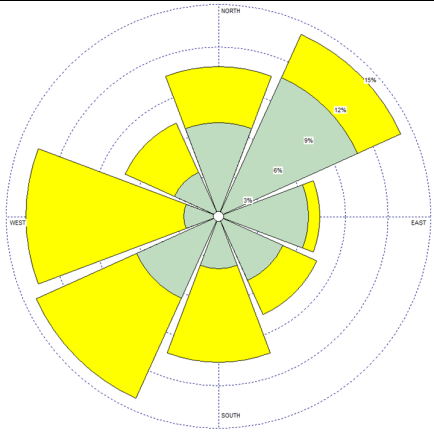
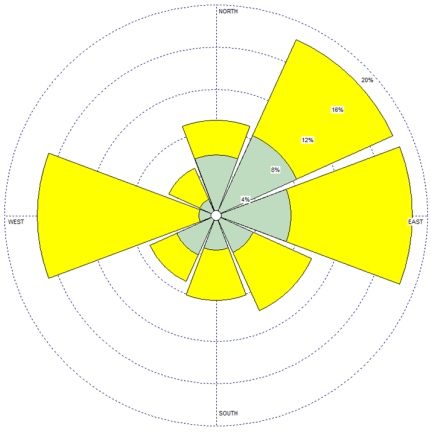
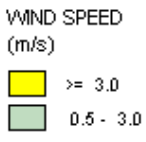
All Seasons	Summer Season (December – February)
	
Average Wind Speed: 3.27 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 3.64 m/s Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 2.68 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 2.89 m/s Axis Frequencies: 3%, 6%, 9%, 12%, 15%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 3.80 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	

Figure 5-2: Wind Rose Plots – BOM Richmond RAAF AWS ID 067105 2017 – Evening time

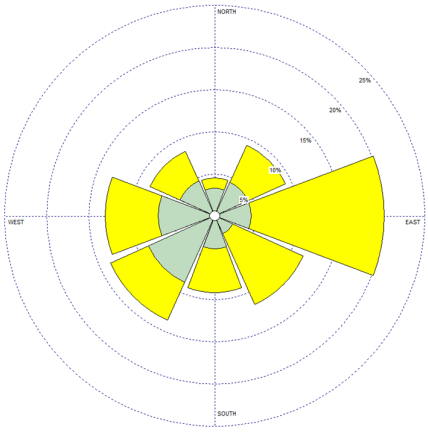
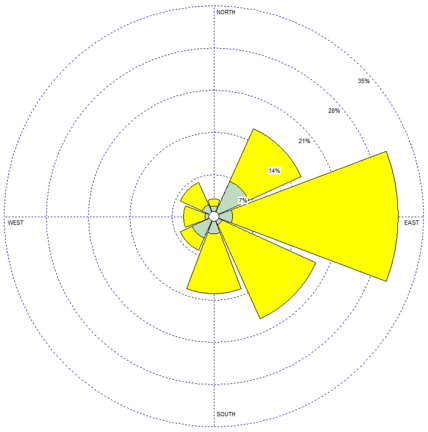
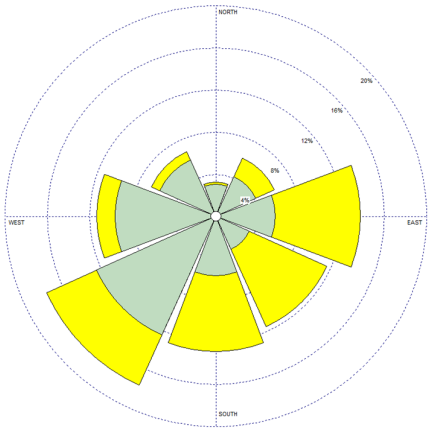
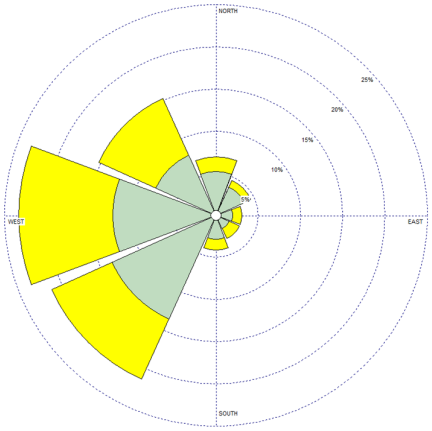
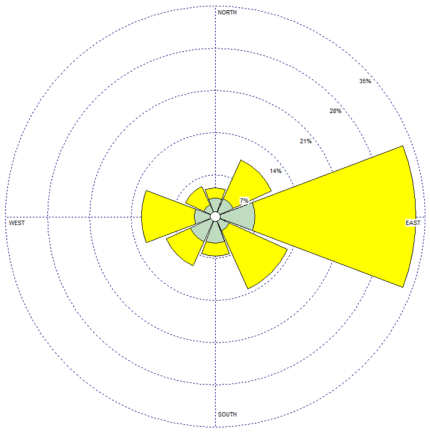
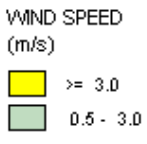
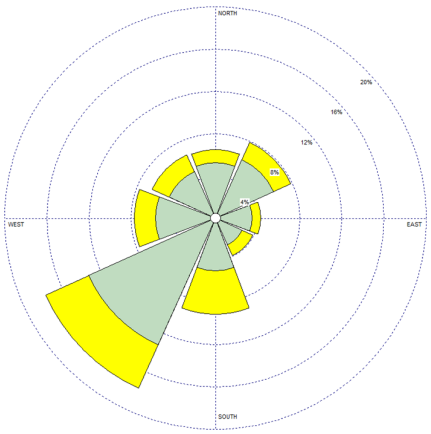
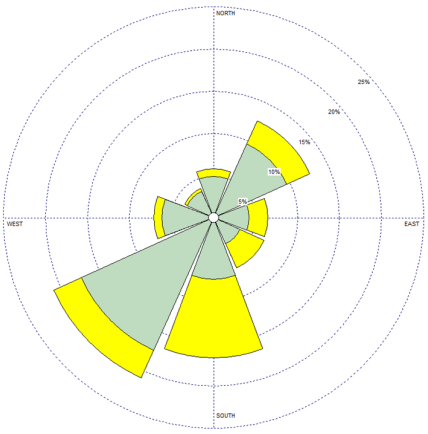
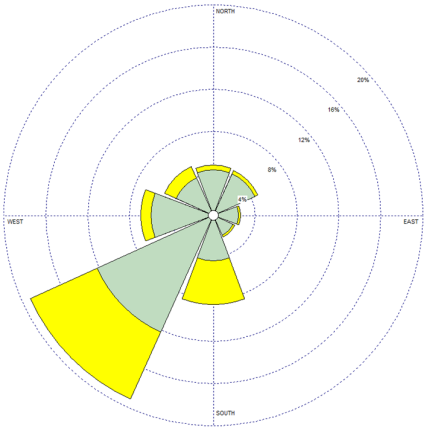
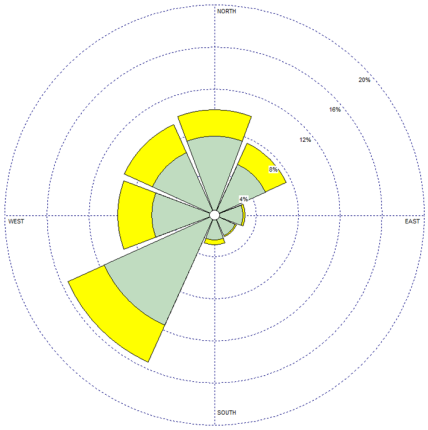
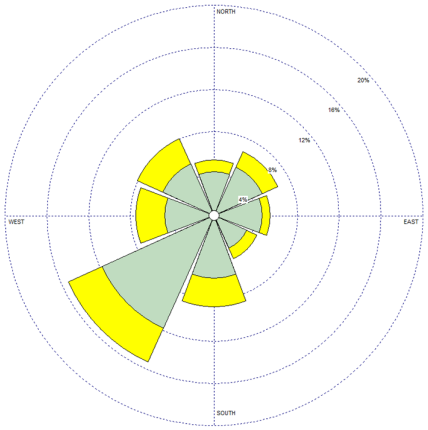
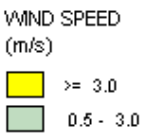
All Seasons	Summer Season (December – February)
	
Average Wind Speed: 3.08 m/s Axis Frequencies: 5%, 10%, 15%, 20%, 25%	Average Wind Speed: 4.24 m/s Axis Frequencies: 7%, 14%, 21%, 28%, 35%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 2.26 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 2.15 m/s Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 4.82 m/s Axis Frequencies: 7%, 14%, 21%, 28%, 35%	

Figure 5-3: Wind Rose Plots – BOM Richmond RAAF AWS ID 067105 2017 – Night time

All Seasons	Summer Season (December – February)
	
Average Wind Speed: 1.48 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 1.97 m/s Axis Frequencies: 5%, 10%, 15%, 20%, 25%
Autumn Season (March – May)	**Winter Season (June – August)**
	
Average Wind Speed: 1.21 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	Average Wind Speed: 1.33 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%
Spring Season (September – November)	**Legend**
	
Average Wind Speed: 1.41 m/s Axis Frequencies: 4%, 8%, 12%, 16%, 20%	

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

5.2 TEMPERATURE INVERSIONS

Temperature inversion is considered a feature where this occurs more than 30% of the nights in winter.

As stated in section 2.2, the site is seeking approval to operate from Monday to Friday 7am to 6pm and Saturday from 8am to 4pm. As the site will not operate during the night period, temperature inversions have not been considered in the noise impact assessment.

5.2.1 Weather Conditions Considered in the Assessment

The following conditions will be considered in this noise impact assessment:

- Condition A: Neutral Weather Conditions.

Details of the considered meteorological conditions have been displayed in Table 5-1.

Table 5-1: Meteorological Conditions Assessed in Noise Propagation Modelling

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

6. CURRENT LEGISLATION AND GUIDELINES

6.1 NSW EPA NOISE POLICY FOR INDUSTRY

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.

6.1.1 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.

6.1.2 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 are reproduced in Table 6-1.

Table 6-1: 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

Source: Table 2.2 NSW Noise Policy for Industry

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.

6.1.3 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.

However, as the development is not proposed to operate during the night period, and therefore a sleep disturbance assessment is not considered warranted.

6.1.4 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).

Table 6-2 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.

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 6-2: 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 $L_{Aeq\ 15\ minute}$
R1-R14	Residential - Rural	Day	35[1]	**40**	50	48	**40**
		Evening	30[1]	**35**	45	43	**35**
		Night	30[1]	**35**	40	38	**35**

Notes:
1) These value are based on the minimum assumed rating background levels as outlined in Table 2.1 of the Noise Policy for Industry.
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).

6.1.5 Annoying Noise Characteristics

In section 3.3.1 of the Noise Policy for Industry is a list of important parameters for predicting noise. Included in that list is the following:

- Annoying characteristics of the noise sources that may be experienced at receiver locations (for example, tonality, low frequency, and intermittency).

Low frequency is of relevance to the development and has been included in this assessment. Further details to assess low frequency noise are described in Fact Sheet C of the Noise Policy for Industry, summarised below.

Table 6-3: Excerpt from Table C1: Modifying factor corrections

Factor	Assessment/ measurement	When to apply	Correction[1]	Comments
Tonal noise	One-third octave bandd analysis using the objective method for assessing the audibility of tones in noise – simplified method (ISO1996.2-2007 – Annex D)	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500-10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160-400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25-125 Hz	5 dB[2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note:** Narrow-band analysis uysing the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/ regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.

Table 6-3: Excerpt from Table C1: Modifying factor corrections

Factor	Assessment/ measurement	When to apply	Correction[1]	Comments
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-thired octave measurements in the range 10-160 Hz	Measure/assess source contribution C- and A-weighted $L_{eq.T}$ levels over the same time period. Correction to be applied where the C minus A level is 15 dB or more and: • Where any of the one-thired octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • Where any of the one-thired octave noise levels in Table c2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2-dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Note 1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the *ISO1996-2:2007* standard.

Tonal is defined as noise containg a prominent frequency and characterised by a definite pitch.

Low frequency noise is defined as noise with an unbalanced spectrum and containing major components within the low-frequency range (10-160 Hz) of the frequency spectrum.

Table 6-4: Excerpt from Table C2: One-third octave low-frequency noise thresholds

Hz/dB(Z)	One-third octave $L_{Zeq,15min}$ threshold level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

Source: Noise Policy for Industry (2017)

6.2 NSW EPA 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 proposal. 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.

6.2.1 Vehicle Route

Vehicles are proposed to access the site from Sargents Road. The potentially most impacted residents to the proposed route are located along Sargents Road between the subject site and Stannix Park Road.

6.2.2 Road Category

Based on the RNP road classification description, Sargents Road would be classified as a 'local roads'.

6.2.3 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant section of Table 3 of the RNP is shown in Table 6-5.

Table 6-5: 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)
Local roads	6. Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 dB (external)	$L_{Aeq\ (1\ hour)}$ 50 dB (external)

* measured at 1 m from a building façade.

6.2.4 Relative Increase Criteria

In addition to the assessment criteria outlined above, any increase in the total traffic noise level at a location due to a proposed project or traffic-generating development must be considered. Residences experiencing increases in total traffic noise levels above the relevant criteria should also be considered for mitigation as described in Section 3.4 of the RNP. For road projects where the main subject road is a local road, the relative increase criterion does not apply.

As Sargents Road is classified as a local road, the relative increase criterion will not be further considered.

6.2.5 Assessment Locations for Existing Land Uses

Table 6-6: 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.

Table 6-6: Assessment Locations for Existing Land Uses

Assessment Type	Assessment Location
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.)
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.

6.2.6 Road Traffic Project Specific Noise Levels

The selected project specific noise levels associated with road traffic noise are presented in Table 6-7.

Table 6-7: Project Specific Noise Levels Associated with Road Traffic, dB(A)

Receptor along	Period	Assessment Criteria L_{eq}
37 Sargents Road (Local Road)	Day	55
	Night	50

6.3 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 BS7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' and other standards.

6.3.1 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 6-8 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 6-8: 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

The considered receivers in this report are all residential receivers. There are no other sensitive land uses in the area surrounding the proposed resource recovery facility.

Noise Criterion

The noise criterion for construction noise is presented in Table 6-9.

Table 6-9: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R12	Residential	Standard Hours	35	45

6.3.2 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.

6.3.3 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 6-10: Vibration criteria for cosmetic damage (BS 7385:2 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse		
	4 Hz 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

6.3.4 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 6-11: 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

6.3.5 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 6-12: 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

Table 6-12: Preferred and maximum weighted rms z-axis values, 1-80 Hz

Location	Daytime		Night time	
	Preferred	Maximum	Preferred	Maximum
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

7. OPERATIONAL NOISE IMPACT ASSESSMENT

7.1 MODELLING METHODOLOGY

7.1.1 Noise Model

Noise propagation modelling was carried out using the ISO 9613-2:1996 algorithm within SoundPLAN. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for existing and proposed developments, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site at the specified receptor, by calculating the contribution of each noise source. Other model inputs included the noise sources, topographical features of the subject area, ground absorption and receiver locations.

The modelling scenarios have been carried out using the $L_{Aeq,\ 15\ minutes}$ descriptor. Using the descriptor, noise emission levels were predicted at the nearest potentially affected sensitive receptors to determine the noise impact against the relevant noise criteria in accordance with the NSW EPA Noise Policy for Industry.

7.1.2 Assumptions Made for Noise Modelling

It should be noted that the relevant assessment period for operational noise emissions has been considered to be 15 minutes. Therefore noise source durations detailed in the following assumptions 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 was obtained from Google Earth.
- On-site topography has been obtained from the site survey plans provided by the client.
- The unloading and processing shed has been modelled as an industrial building with internal point sources. The roof and walls of the industrial building have been considered to be constructed of 0.5 mm colorbond sheet steel (R_w = 22 dB). The floor has been modelled as concrete.
- The roller shutter doors and pedestrian doors have been modelled in the open position for the entire 15 minute scenario.
- All receptors were modelled at 1.5 m above ground level.
- All ground areas have been modelled considering different ground factors ranging from 0 to 1 (Soft to Hard ground). The subject site and immediate surrounding rural area have been modelled with a ground absorption factor of 1.0 (soft).
- One (1) truck has been modelled entering the site as a worst case scenario over a 15 minute period. An on-site speed of 10 km/hr has been considered.

- Internal noise sources associated with the site activities (i.e. triple deck screen and concrete crusher) have been modelled as point sources and will be operational for 100% of the operational hours of the site.

- Outdoor noise sources (i.e. the truck manouvering, excavator and front end loader) have been modelled as point or line sources and will be operational for 100% of the 15 minute operational period.

An outline of the noise sources and operational noise modelling scenarios has been provided below.

7.1.3 Noise Sources

A-weighted octave band centre frequency sound power levels are presented in Table 7-1 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 extensive noise source database.

Table 7-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	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
Concrete Jaw Crusher Komatsu BR380JG-1 (running loaded)	108	25	30	43	45	48	58	56	60	63	72
		80	80	78	83	85	84	81	82	81	78
		77	75	70	71	66	59	52	46	44	35
Triple Deck Screen	104	29	28	47	49	51	52	56	56	60	63
		65	69	70	71	74	74	76	77	78	78
		78	80	76	72	70	67	61	57	51	44
25T Excavator	102	-	-	-	-	82	-	-	85	-	-
		91	-	-	97	-	-	96	-	-	95
		-	-	92	-	-	85	-	-	-	-
Front End Loader	102	34	54	54	50	57	65	54	50	52	57
		55	56	53	53	61	78	102	72	64	58
		46	46	46	48	50	50	42	46	51	52
Truck Engine	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	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	-	-	-

7.1.4 Noise Modelling Scenarios

One operational scenario was considered in the noise model. The noise generating scenario considered a situation where all noise sources on site were operating over the 15 minute assessment period simulating a worst case situation (Scenario 1). This scenario was remodelled with the eastern most roller shutter (door 4) closed (Scenario 2). The equipment list is detailed in Table 7-2, with an equipment location diagram in Figure 7-1.

Table 7-2: Modelled Noise Scenarios for Proposed Operations

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
Scenario 1	Monday – Friday 7am to 6pm Saturday 8am to 4pm	Indoor Noise Sources • Triple decker screen • Crusher Outdoor Noise sources • Truck manouvering • Front end loader (50% inside / 50% outside) • Excavator (50% inside / 50% outside)
Scenario 2	Monday – Friday 7am to 6pm Saturday 8am to 4pm	Indoor Noise Sources • Triple decker screen • Crusher Outdoor Noise sources • Truck manouvering • Front end loader (50% inside / 50% outside) • Excavator (50% inside / 50% outside) Noise Control: Roller Shutter Door 4 closed (eastern most door)

Figure 7-1: Noise Source Locations

7.2 OPERATIONAL PREDICTED NOISE LEVELS

Results of the predictive noise modelling of the operational activities are shown in Table 7-3.

During operations, noise levels are predicted to comply with the Noise Policy for Industry criteria at all receivers during all scenarios at all recievers except R11 where a residual noise level of 1 dB(A) is predicted for scenario 1. This can be brought into compliance as shown in the predicted results from scenario 2 by closing roller shutter door 4 (eastern most roller shutter door) when the crusher is operating.

It is therefore concluded that the proposed site activities will not have a detrimental impact on the neighbouring receivers, if the noise control measures in section 7.3 are carried out.

Noise Contours are provided in attachment 4.

Table 7-3: Noise Modelling Results Associated with Operational Activities, L_{eq}, dB(A)

Receiver	Criteria: PNTL ($L_{eq,15\ minute}$ dB(A)) – Day	Predicted: Scenario 1 ($L_{eq,15\ minutes}$, dB(A))	Predicted: Scenario 2 ($L_{eq,15\ minutes}$, dB(A))
R1	40	19✓	19✓
R2	40	22✓	22✓
R3	40	22✓	22✓
R4	40	18✓	18✓
R5	40	18✓	18✓
R6	40	27✓	27✓
R7	40	31✓	31✓
R8	40	36✓	35✓
R9	40	35✓	34✓
R10	40	37✓	36✓
R11	40	41×	40✓
R12	40	34✓	34✓
R13	40	37 ✓	37 ✓
R14	40	38 ✓	38 ✓

7.2.1 Annoying Characteristics

7.2.1.1 Low Frequency

Low frequency noise for the two scenarios described in this section, has been further evaluated as part of this assessment, due to some exceedances of 15 dB when source contribution A weighted is minused from C weighted in one-third octave measurements in the range 10-160 Hz. R11 has been assessed as it is cumulatively the worst receiver for low frequency noise. The results of the low frequency levels at R11 are shown below for both scenarios.

Table 7-4: Predicted Low Frequency Contribution

	Worst Case Receiver	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz
Threshold levels	-	69	61	54	50	50	48	48	46	44
Scenario 1	R11	25✓	33✓	31✓	45✓	49✓	33✓	26✓	35✓	25✓
Scenario 2	R11	25✓	33✓	31✓	45✓	49✓	33✓	26✓	35✓	24✓

The results show that low frequency does not warrant a penalty as the threshold is not exceeded at any of the frequencies for the worst case receiver.

7.2.1.2 Tonality

Third octave band analysis has revealed no tonal elements in the results at the worst case receiver R11.

7.3 NOISE CONTROL MEASURES

In order to achieve the predicted compliance levels at the nearest receptors, the following control measures are recommended to be implemented.

- As per section 2.2, site activities are recommended to be limited to the day period.
- As per section 7.1.2, the crushing and screening activities are recommended to take place inside the unloading and processing shed.
- Eastern most roller shutter door (roller shutter door 4) is closed when the crusher is operating.
- It is recommended mobile equipment regularly used onsite such as the excavator and front end loader be fitted with reversing lights or a white noise reversing alarm.

It is also recommended the following additional management practices be implemented:

- 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; and
- On-site vehicles to be maintained in accordance with a preventative maintenance program to ensure optimum performance and early detection of wearing or noisy components;

8. ROAD TRAFFIC NOISE IMPACT ASSESSMENT

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

Calculation of road traffic noise contribution has been undertaken using SoundPLAN. It is understood that a maximum of 2 truck movements are proposed per hour during the day between 7am and 5pm, however 4 truck movements have been modelled as a worst case scenario in line with the operational noise assessment No truck movements are proposed during the night period. Vehicles are assumed to travel along Sargents Road at the posted speed of 50 km/h.

Two line sources have been modelled to represent truck traffic along Sargents Road at the rate of 4 truck movements per hour, one truck movement in each direction. Line sources have used a truck engine SWL of 103 dB(A) at a height of 1.5 m and a truck exhaust SWL of 106 dB(A) at a height of 3 m. It is understood that the road is unsealed so and additional +4 dB(A) has been added to the truck engine SWL to make it 107 dB(A). The $L_{Aeq,\ 1\ hour}$ noise descriptor has been calculated at the most affected residential receptor located along Sargents Road – 37 Sargents Road, Ebenezer which is located 25 m from the road. The receiver has been placed 1.5 m above the ground and 1 m from the façade of the residence. The following figure shows this receiver and the truck line sources.

Figure 8-1: Road Noise Model

The predicted noise levels are displayed in Table 8-1. The highest noise levels would be predicted at this location, therefore they are the only results displayed.

Table 8-1: Predicted Levels for Road Traffic Noise

Receptor	Noise Criteria		Site Contribution	
	Day $L_{Aeq, 1\ hour}$	Night $L_{Aeq, 1\ hour}$	Day $L_{Aeq, 1\ hour}$	Night $L_{Aeq, 1\ hour}$
37 Sargents Road, Ebenezer	55	50	45 ✓	N/A ✓

For the residential dwellings that front onto Sargents Road, the predicted noise levels associated with the vehicle movements from the site would be below the daytime criteria of $L_{Aeq\ (1\ hour)}$ 55 dB for local roads.

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

9. CONSTRUCTION NOISE IMPACT ASSESSMENT

9.1 CONSTRUCTION ACTIVITIES

Construction activities are proposed to include the following:

- Site establishment;
- The building of the unloading and processing shed; and
- The installation of a wash bay and weighbridge;

9.2 MODELLED NOISE GENERATING SCENARIOS

Considering the construction activities outlined in section 9.1, the three construction stages listed in Table 9-1 are modelled for civil works, concreting works and structure works. The noise generating stages consider a worst case scenario in which all equipment is running for 100% of the time over the 15 minute assessment period.

The equipment list for the stages is detailed in Table 9-1, with an equipment location diagrams in Figure 9-1 to Figure 9-3. Equipment is primarily located in the area of the proposed unloading and processing shed, as the majority of the construction works will take place at this location.

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 9-1: Modelled Noise Stages for Proposed Construction Works

Scenario	Time of the day	Noise Sources for Worst 15-minute Period
Stage 1. Civil Works	Standard hours	• Dozer • Backhoe • Truck • Hand tools
Stage 2. Concreting construction works	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools
Stage 3. Structure construction works	Standard hours	• Truck • Crane • Hand Tools

Figure 9-1: Construction Stage 1 – Civil Works

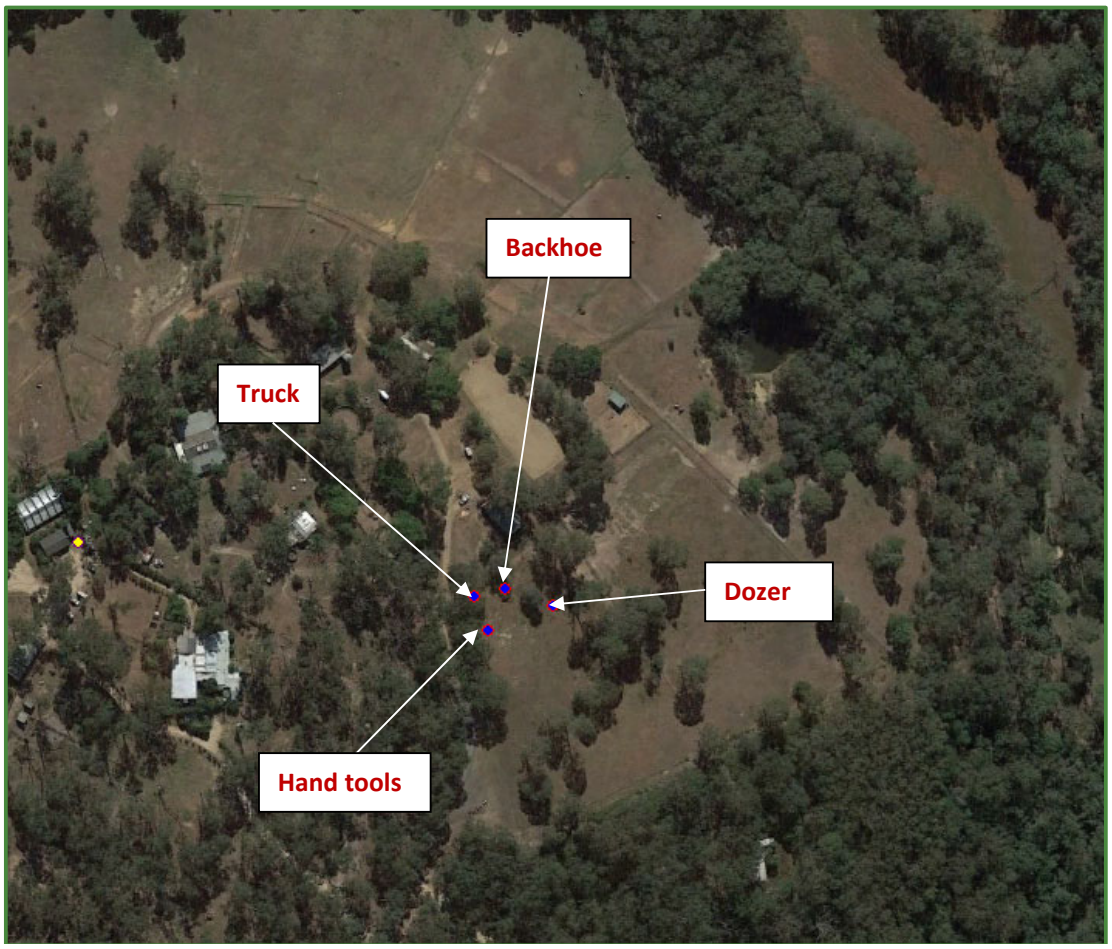


Figure 9-2: Construction Stage 2 – Concreting Construction Works

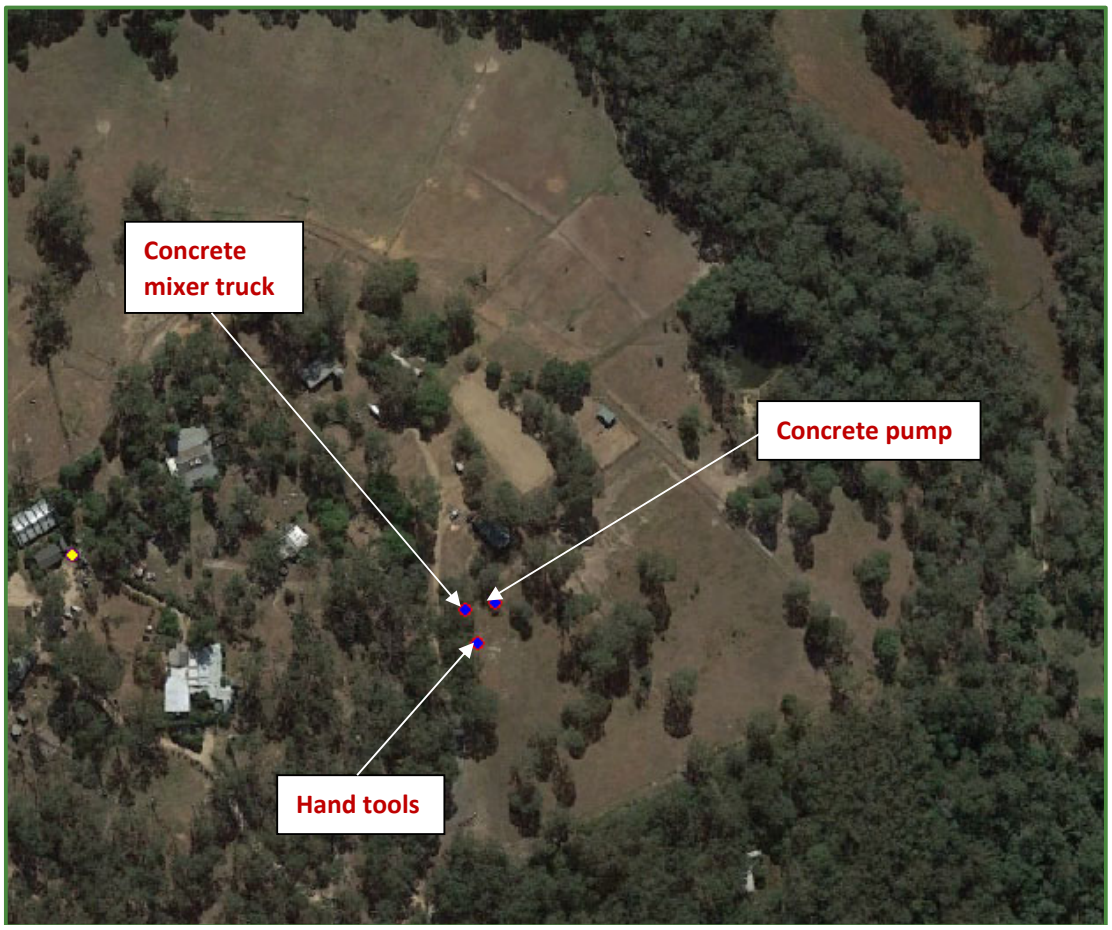
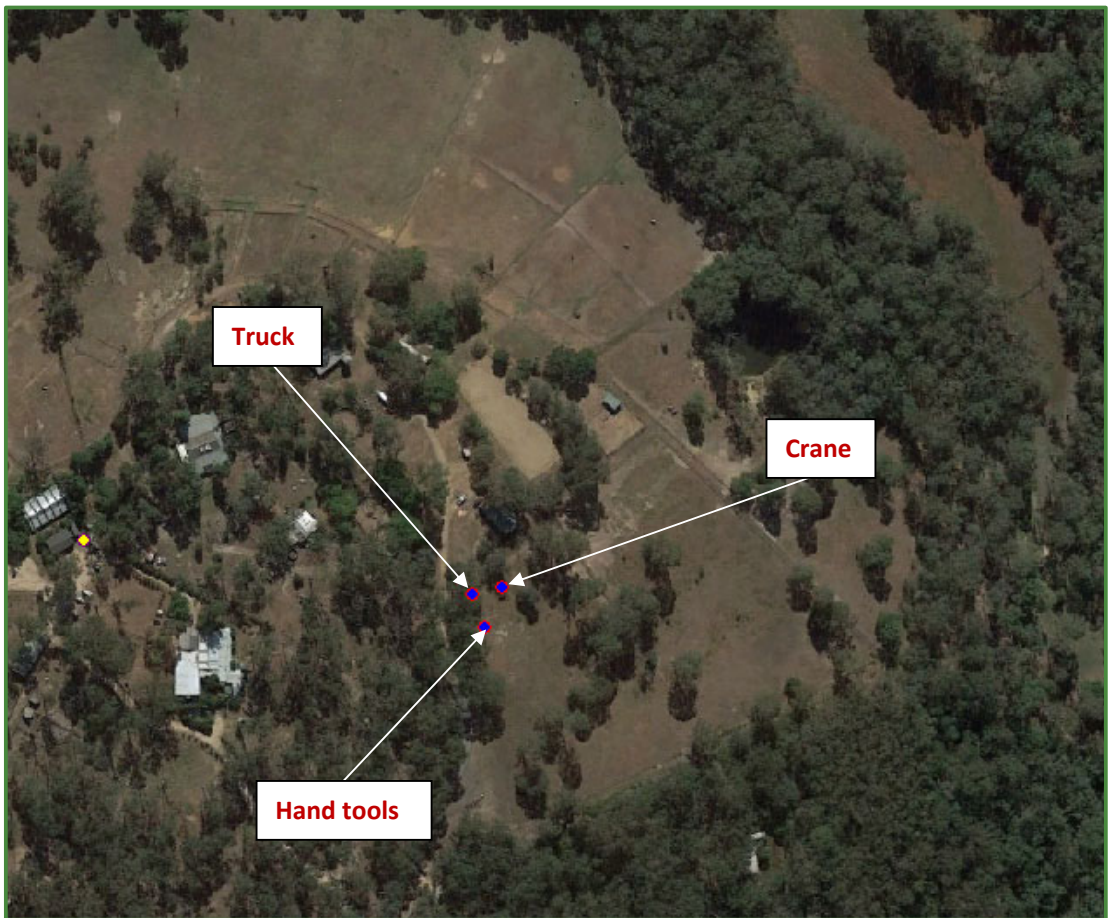


Figure 9-3: Construction Stage 3 – Structure Construction Works



9.3 MODELLING METHODOLOGY

9.3.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the ISO 9613 algorithm within SoundPLAN. The construction stages were modelled using the $L_{Aeq,\ 15\ minutes}$ descriptor.

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

- The relevant assessment period for operational noise emissions has been considered to be 15 minutes. Construction stages assume all equipment is running 100% of the time during the 15 minute assessment period, to provide a worst case scenario;
- Topographical information for off-site areas was obtained from Google Earth;
- Topographical information for on-site areas was obtained from the site survey;
- All receptors were modelled at 1.5 m above ground level;

- The surrounding ground areas have been modelled with a ground absorption coefficient of 1.0 (soft); and

- All noise sources associated with the construction works have been modelled as point sources.

9.3.2 Noise Sources

A-weighted octave band centre frequency sound power levels are presented shown in Table 9-2 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 9-2: 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
Truck	**102**	73	81	86	101	92	90	85	85
Dozer	**105**	75	89	94	100	100	98	92	82
Backhoe	**96**	76	78	83	89	91	89	88	77
Hand tools	**100**	71	81	91	96	94	90	87	81
Concrete truck	**108**	85	86	85	94	98	107	89	82
Concrete pump truck	**105**	77	92	97	99	100	95	95	89
Crane	**106**	90	95	99	100	100	98	90	80

9.4 CONSTRUCTION PREDICTED NOISE LEVELS

Results of the predictive noise modelling of the construction activities are shown in Table 9-3. Compliance is predicted with the day noise criteria at all receptors and stages of construction apart from receptors R13 and R14 which exceed for all three scenarios. However noise levels are predicted to be well below the highly noise affected criteria of 75 dB(A).

Table 9-3: Noise Modelling Results Associated with Construction Activities for L_{eq}, dB(A)

Receiver	Criteria: PSNL ($L_{eq,15\ minute}$ dB(A))	Predicted Levels: Stage (Standard Hours) (L_{eq}, dB(A))		
	Standard Hours	1	2	3
R1	45	24 ✓	25 ✓	25 ✓
R2	45	27 ✓	28 ✓	28 ✓
R3	45	28 ✓	29 ✓	29 ✓
R4	45	24 ✓	25 ✓	26 ✓
R5	45	24 ✓	24 ✓	26 ✓
R6	45	31 ✓	33 ✓	34 ✓
R7	45	39 ✓	40 ✓	41 ✓
R8	45	34 ✓	34 ✓	35 ✓
R9	45	32 ✓	33 ✓	33 ✓
R10	45	34 ✓	36 ✓	35 ✓
R11	45	40 ✓	42 ✓	40 ✓
R12	45	37 ✓	40 ✓	38 ✓
R13	45	47 ×	51 ×	49 ×
R14	45	49 ×	53 ×	50 ×

✓Complies × Non-compliance

9.4.1 Construction Noise Mitigation Measures

Construction activities should only take place during standard **construction** hours only as follows:

Monday to Friday:	7am to 5pm (with no hammering or saw-cutting to occur before 7.30am)
Saturday:	8am to 1pm (with no hammering or saw-cutting to occur before 8.30am)
Sunday and Public Holidays:	No works permitted

As stated in Table 2 of the Interim Construction Noise Guideline:

- Where the predicted of measured $L_{Aeq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.
- The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

9.4.1.1 Universal Work Practices

Universal work practices from section 6 of the *Industrial Construction Noise Guideline* are recommended to be adopted, including the following:

- Regularly train workers and contractors (such as at toolbox talks) to use equipment in ways to minimise noise.
- Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- Include in tenders, employment contracts, subcontractor agreements and work method statements clauses that require minimisation of noise and compliance with directions from management to minimise noise.
- Avoid the use of radios or stereos outdoors where neighbours can be affected.
- Avoid the overuse of public address systems.
- Avoid shouting and minimise talking loudly and slamming vehicle doors.
- Keep truck drivers informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes or compression braking, and no extended periods of engine idling).
- Develop a one-page summary of approval or consent conditions that relate to relevant work practices and pin it to a noticeboard so that all site operators can quickly reference noise information.
- Workers may at times need to discuss or negotiate practices with their managers.

9.4.1.2 Plant and Equipment

As per section 6 of the *Industrial Construction Noise Guideline* controlling construction and demolition noise at the source is recommended to be done by the following means:

Use quieter methods

- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric controlled units where feasible and reasonable. Where there is no electricity supply, use an electrical generator located away from residences.

Use quieter equipment

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine.
- Pneumatic equipment is traditionally a problem – select silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.
- When purchasing, select, where feasible and reasonable, the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.

Operate plant in a quiet and efficient manner

- Reduce throttle setting and turn off equipment when not being used.

Maintain equipment

- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.
- Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
- Ensure air lines on pneumatic equipment do not leak.

9.4.1.3 On Site

On site location of plant should be considered where possible, as per section 6 of the *Industrial Construction Noise Guideline*:

Location of plant

- Place as much distance as possible between the plant or equipment and residences and other sensitive land uses.
- Restrict areas in which mobile plant can operate so that it is away from residences and other sensitive land uses at particular times.
- Locate site vehicle entrances away from residences and other sensitive land uses.

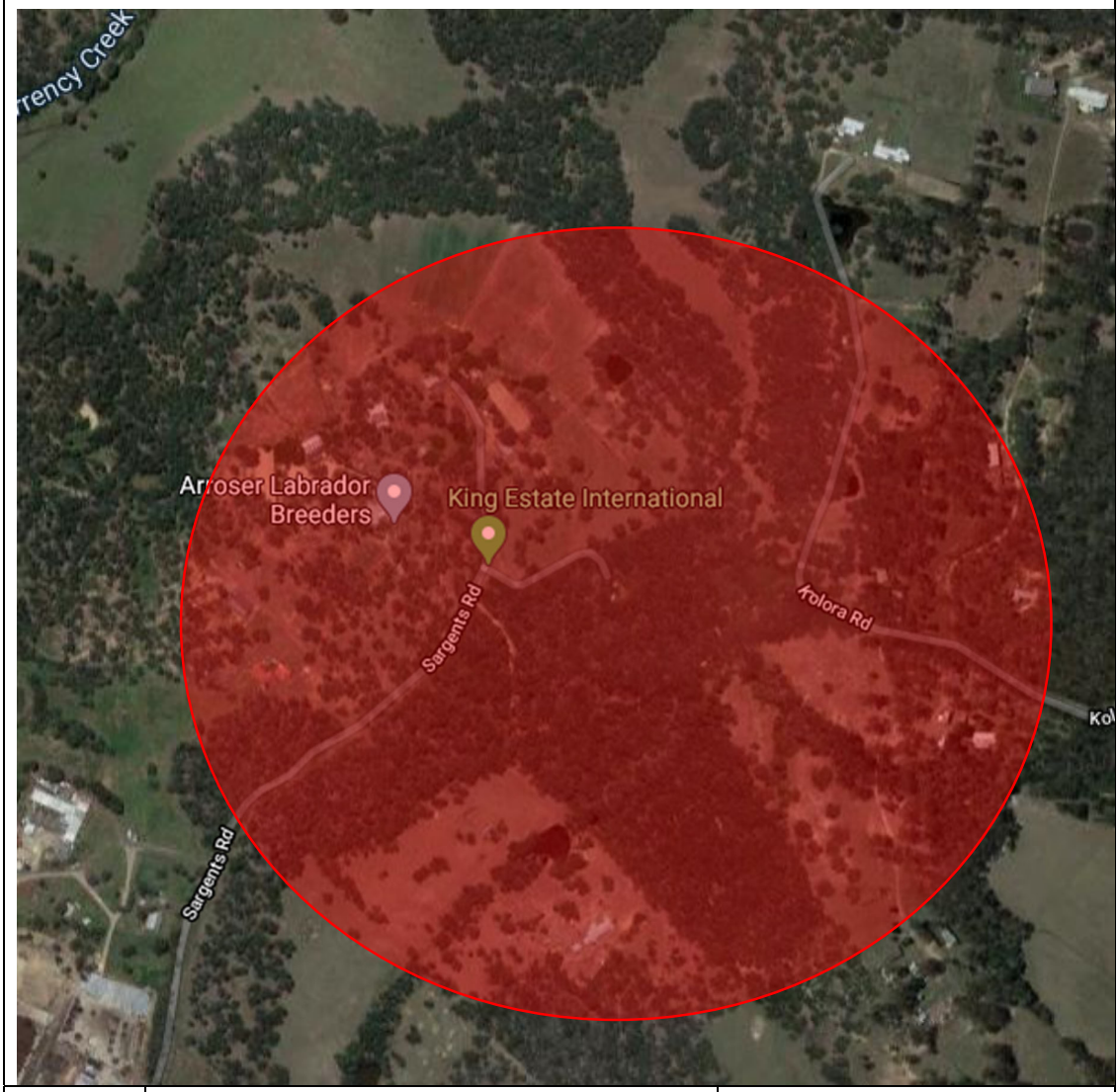
Alternatives to reversing alarms

- Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive through for parking and deliveries and using spotters and traffic controllers.
- Install where feasible and reasonable less annoying alternatives to the typical 'beeper' alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multi frequency alarms that emit noise over a wide range of frequencies.
- In all circumstances, the requirements of the relevant Occupational Health and Safety legislation must be complied with. For information on replacing audible warning alarms on mobile plant with less annoying alternatives, see Appendix C of the *Industrial Construction Noise Guideline*.

9.4.1.4 Communication with Residents

The residents shown in the highlighted area in Figure 9-4 should be informed of the construction work to be carried out at the site and the period in which this will be done, as well as site contacts provided in case there are any issues.

Figure 9-4: Community Communication Map



N	LEGEND: Residents to be communicated within	Benbow Environmental 25-27 Sherwood Street, Northmead NSW 2152

10. STATEMENT OF POTENTIAL NOISE IMPACT

A noise impact assessment was undertaken to assess the potential noise emissions from the proposed landscape material supplies and resource recovery development located at 99 Sargents Road, Ebenezer.

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

- NSW Environment Protection Authority Noise Policy for Industry 2017;
- Department of Environment, Climate Change and Water NSW Road Noise Policy 2011; and
- Department of Environment, Climate Change and Water NSW Interim Construction Noise Guideline 2009.

The nearest receivers and noise criteria were identified. The site operations were modelled using the predictive noise software, Sound Plan.

The activities proposed by the proponent were found to be within the framework of the NSW Noise Policy for Industry. The noise generating scenarios are predicted to comply with the project specific noise levels at all receivers. Recommendations for noise controls are given in section 7.3, including operational hours and site management practices.

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

Compliance with the guidelines set out in the Interim Construction Noise Guideline was predicted at the vast majority of receivers. Recommended noise controls for construction works are listed in section 9.4.1.

This concludes the report.

Emma Hansma	Victoria Hale	R T Benbow
Senior Engineer	Environmental Scientist	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 Hala Constructions Pty Ltd, as per our agreement for providing environmental services. Only Hala Constructions Pty Ltd 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 Hala Constructions Pty Ltd 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 Glossary

Glossary of 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, L_{Aeq}

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 L_{Aeq} 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.

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.

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.

MAXIMUM NOISE LEVEL, L_{AFmax}

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.

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."

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).

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 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. $L_w = L_p + 10 \log_{10}$ 'a' dB, re: 1pW, (10^{-12} watts) where 'a' is the measurement noise-emission area (m^2) in a free field.

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, R_w

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 ISO 717-1:2004). Internal partition wall R_w + 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 C_{tr} 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.

'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: 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 Kiett

.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

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 Rock

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.

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Mobile: 0413 809806
web site: www.acu-vib.com.au

Attachment 3: Noise 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 IEC 61672.1–2004 Electroacoustics – Sound level meters - Specifications.

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 2.

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 IEC 61672.1–2004 Electroacoustics – Sound level meters - Specifications.

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 logger type NGARA and EL-215 were used to conduct the long-term unattended noise monitoring. This equipment complies with Australian Standard AS IEC 61672.1–2004 *Electroacoustics – Sound level meters – Specifications* and are designated as a 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 2.

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.

Measurements affected by wind or rain over certain limits were excluded from the final analyses of the recorded data in accordance with the EPA's Noise Policy for Industry. The wind data were modified to take into account the difference of height between the AWS (Automatic Weather Station) used by the Bureau of Meteorology (10 m above ground level), and the microphone (1.5 m above ground level). The correction factor applied to the data was calculated according to the Australian Standard AS 1170.2 2011 .

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}, L_{Aeq} and L_{Amax} levels were 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. The L_{Aeq} level is the equivalent continuous noise level or the level averaged on an equal energy basis which is used to describe the "Ambient Noise". The L_{Amax} noise levels are maximum sound pressure levels measured over the sampling period and this parameter is commonly used when assessing noise impact.

Measurement sample periods were fifteen minutes. The Noise -vs- Time daily noise logger charts representing measured noise levels at the noise monitoring locations are presented in Attachment 4.

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meters. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS IEC 61672.1-2004 and was set on A-weighted, fast response.

The microphone was positioned at 1.2 to 1.5 metres above ground level and was fitted with windsocks. 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 2.

WEATHER CONDITIONS

It was clear, 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: Noise Contour Plots