NOISE AND VIBRATION IMPACT ASSESSMENT
SMITHFIELD BATTERY ENERGY STORAGE SYSTEM
6 HERBERT PLACE, SMITHFIELD

Prepared for: Iberdrola Australia

Prepared by: Bethany Carlyon, Graduate Environmental Scientist
Emma Hansma, Senior Engineer
R T Benbow, Principal Consultant

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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:
Bethany Carlyon	Graduate Environmental Scientist		01 November 2023
Emma Hansma	Senior Engineer		01 November 2023
Reviewed by:	**Position:**	**Signature:**	**Date:**
Emma Hansma	Senior Engineer		01 November 2023
R T Benbow	Principal Consultant		01 November 2023
Approved by:	**Position:**	**Signature:**	**Date:**
R T Benbow	Principal Consultant		01 November 2023

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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

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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

Benbow Environmental has been commissioned by Iberdrola Australia to undertake a noise impact assessment (NIA) to assess the noise impacts associated with the installation and operation of a battery energy storage system (BESS) at the existing Smithfield Energy Facility (SEF).

This noise impact assessment includes:

- Consideration of current legislation and guidelines including:
    - Noise Policy for Industry (2017);
    - NSW Interim Construction Noise Guidelines (2009);
    - NSW Road Noise Policy (2011);
- Background noise monitoring;
- Modelling of the existing facility based on-site measurements;
- Modelling of proposed additional BESS noise;
- Assessment of low frequency noise;
- Recommendations of mitigation measures; and
- A statement of predicted compliance.

The findings of this assessment indicate that the noise levels from the proposed development would comply at all residential receptors for all applicable weather conditions during all time periods.

The existing and proposed development was assessed against the low frequency noise requirements of the Noise Policy for Industry (2017) and found that due to the existing peaking plant, a 2 dB(A) penalty applies at select receptors. With the addition of the low frequency noise penalty the existing development would comply with the Project Noise Trigger Levels at all receptors during all time periods and applicable weather conditions. Additionally, with the proposed addition of the BESS facility the cumulative noise is predicted to comply with the Project Noise Trigger Levels at all residential receptors during all time periods with the addition of a 2 dB(A) penalty.

A residual noise impact above the project noise trigger levels is predicted at the neighbouring industrial facility to the north of the site (Lot 1000 DP1077000) as shown in Figure 7-5 and Figure 7-6. The region that exceeds the criteria (68 dB(A)) is the hardstand area currently being used as a truck depot/material storage area to the north and is not predicted to exceed the criteria at the existing neighbouring industrial buildings.

The noise levels from the thermal system consists of two components with 4 out of 9 fans cooling the power electronics (PE Fans) and 5 out of 9 fans cooling the battery modules. The predicted noise levels are based on a reasonable worst case fan duty (100% battery fan operations, and 20% PE fan operations), where all 36 units are operating at 100% load. In practice this would only occur for approximately 5% of the time on the hottest days of the year. In practice most of the time (>95% of the time over the year) the PE fans operate at 20% duty or less and the battery fans operate at 40% duty or less, under these typical conditions the noise levels from each BESS unit will be more than 10 dB(A) less than those modelled as worst-case and would easily achieve compliance at the neighbouring industrial site.

A review of mitigation measures with regards to effectiveness and reasonability/feasibility was undertaken in accordance with the NPfI. The review identified:

- an operational Noise Management Plan (NMP) should be developed to minimise the risk of adverse noise impacts during the operation of the facility;
- a noise complaints procedure should be developed; and
- noise monitoring should occur if complaints are received.

These are discussed further in Section 7.4.

Construction noise mitigation measures include:

- consultation with nearby receivers;
- on-site management; and
- choosing appropriate plant and equipment, and maintaining regularly.

These are discussed further in Section 9.3.1.

A proposed northern boundary's fence of 2.1 m has been modelled across the length of the northern boundary. This is made from Colorbond steel.

Based on the above considerations the noise from the proposed development does not significantly impact the existing environment and the site is deemed suitable for the proposed use.

Construction noise impacts are predicted to comply with the NSW Interim Construction Noise Criteria at all receivers. Vibration impacts are expected to be negligible. A detailed vibration assessment is not considered warranted. Road noise impacts have been assessed and readily achieve compliance with the RNP.

Emma Hansma
Senior Engineer

Bethany Carlyon
Graduate Environmental Scientist

R T Benbow
Principal Consultant

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1. INTRODUCTION

Benbow Environmental has been commissioned by Iberdrola Australia to undertake a noise impact assessment (NIA) to assess the noise impacts associated with the installation and operation of a battery energy storage system (BESS).

This NIA has been prepared to assess both construction and operational noise impacts, specifically;
1. Construction noise associated with the installation and operation of the new BESS facility;
2. Operational noise associated with the amended Smithfield Energy Facility which includes 72 MW BESS and the existing peaking plant.

1.1 SCOPE OF WORKS

This noise impact assessment includes the following:

- Identify operational Project Noise Trigger Levels and construction and road noise criteria;
- Determine all potential noise sources associated with the existing and proposed development;
- Predict potential noise impacts at the nearest potentially affected receptors to the site;
- Assess potential noise impacts against Project Noise Trigger Levels; and
- Provide noise performance requirements and mitigation measures necessary for compliance.

2. PROPOSED DEVELOPMENT

2.1 BACKGROUND – APPROVED PROJECT

The Smithfield Energy Facility (SEF) located at 6 Herbert Place Smithfield, Lot 33 DP 850596, has converted the Combined Cycle Cogeneration Plant to peaking plants. This involved placing the heat recovery steam generators (HRSGs) and existing stacks, three of the four cooling towers and the steam turbine on care and maintenance.

Figure 2-1: Existing layout

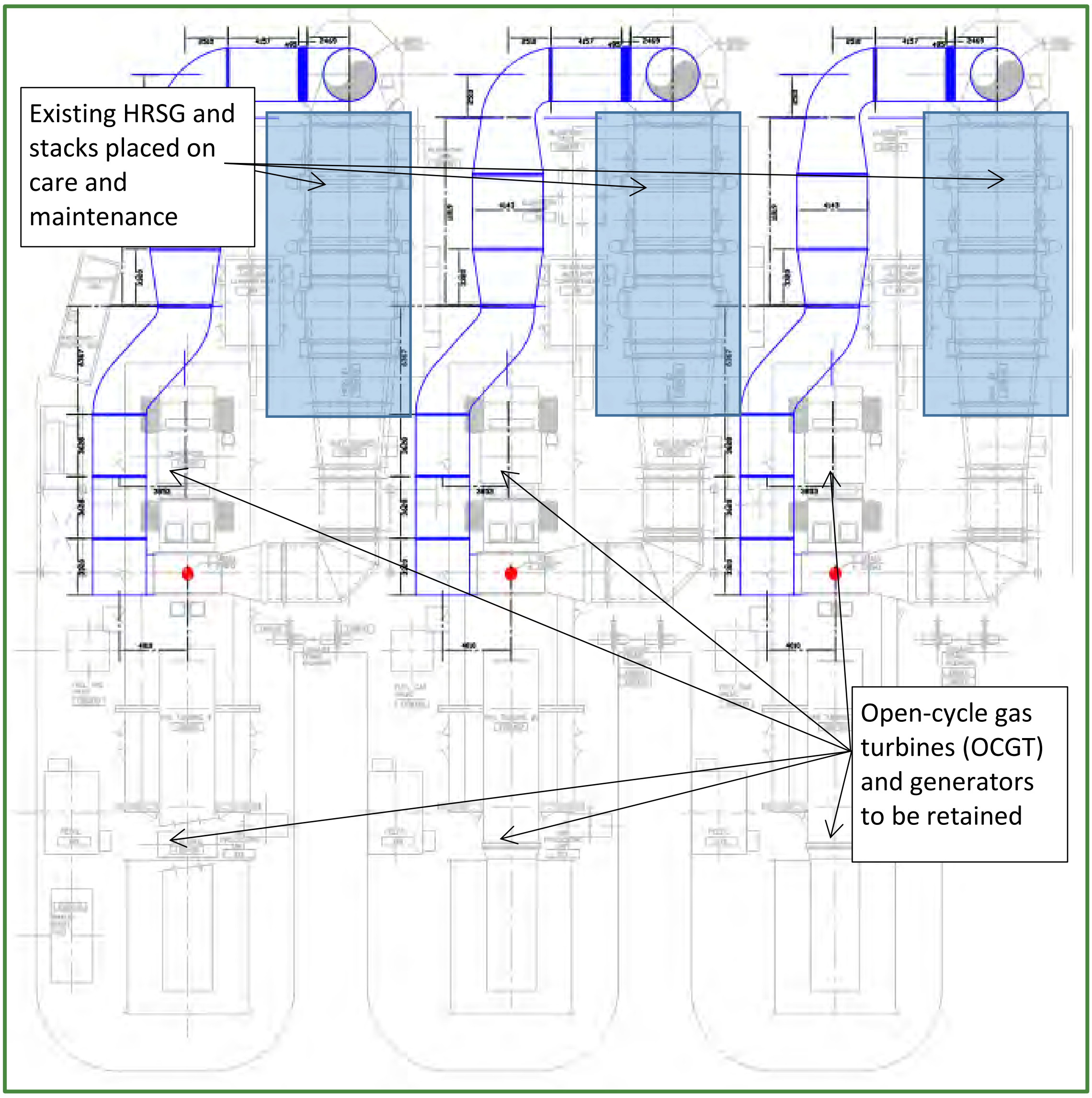
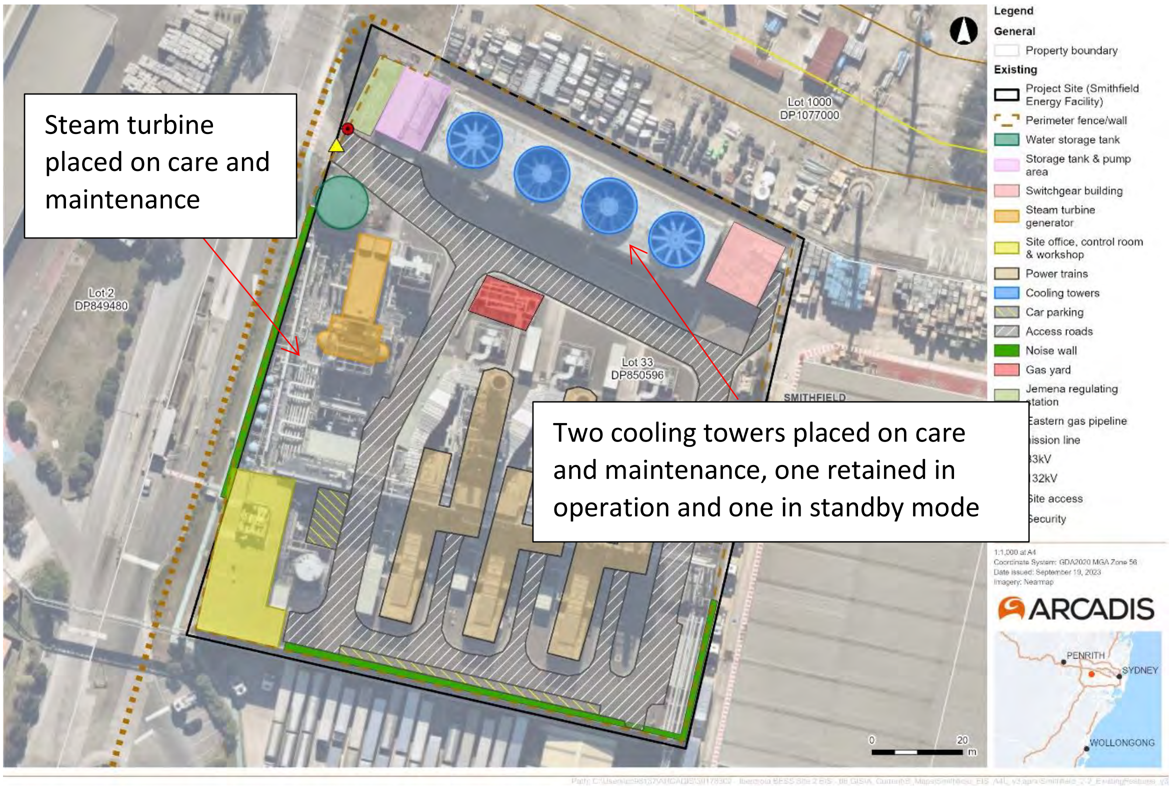


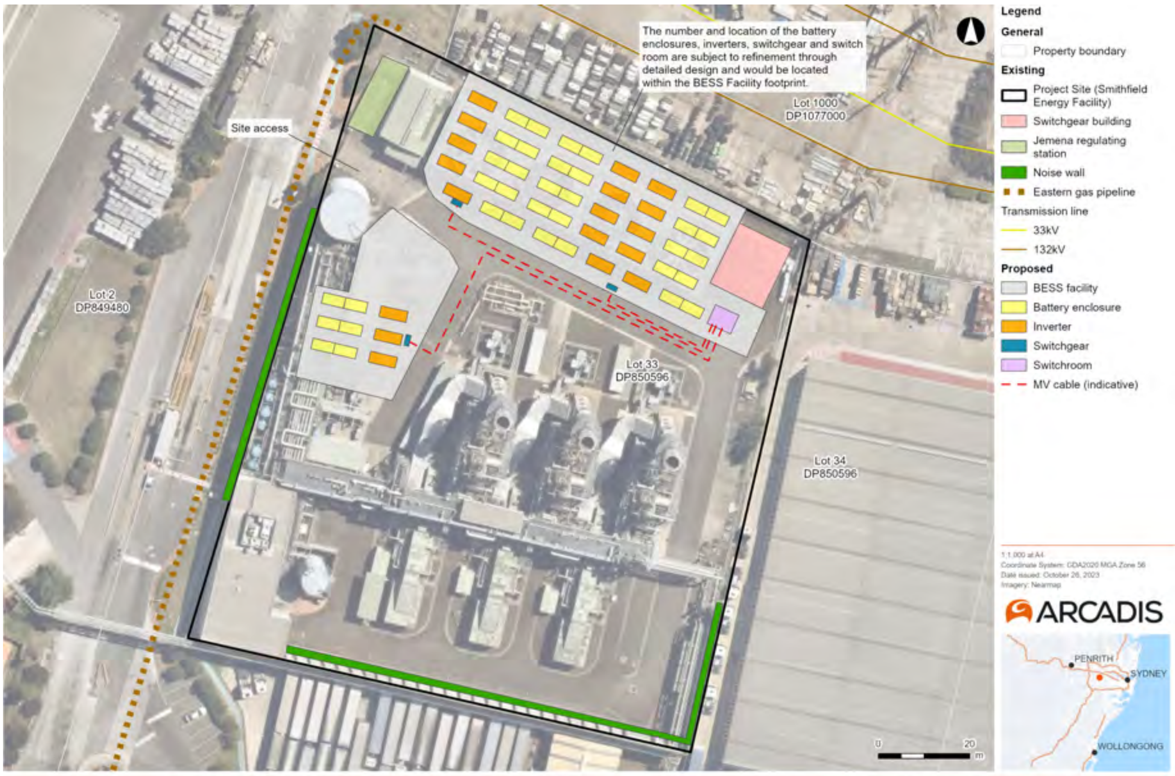
Figure 2-2: Existing site



2.2 PROPOSED DEVELOPMENT

The proposed development is for the installation and operation of a 72 MW BESS facility in the location of the old cooling towers. Ultimately, the proposed development would continue to operate as a peaking plant. There is no change to the existing function other than not having the ability to return to co-generation.

Figure 2-3: Proposed Development



2.3 HOURS OF OPERATIONS

The plant is proposed to operate sporadically 24 hours a day, 7 days a week.

3. NEAREST SENSITIVE RECEIVERS

The nearest sensitive receptors are listed in Table 3-1 and their location is shown in Figure 3-1. These receptors are the closest in distance to the proposed development. As such, these receptors are considered to represent the primary receptors likely to be affected by noise emissions associated with the proposed development. Thus, compliance at these receptors would result in compliance at all locations. There are active recreational areas around the site. These are not included as sensitive receptors as they are less sensitive than residential; contour plots are provided in section 7.3 for reference of impacts.

Table 3-1: Nearest Sensitive Receptors

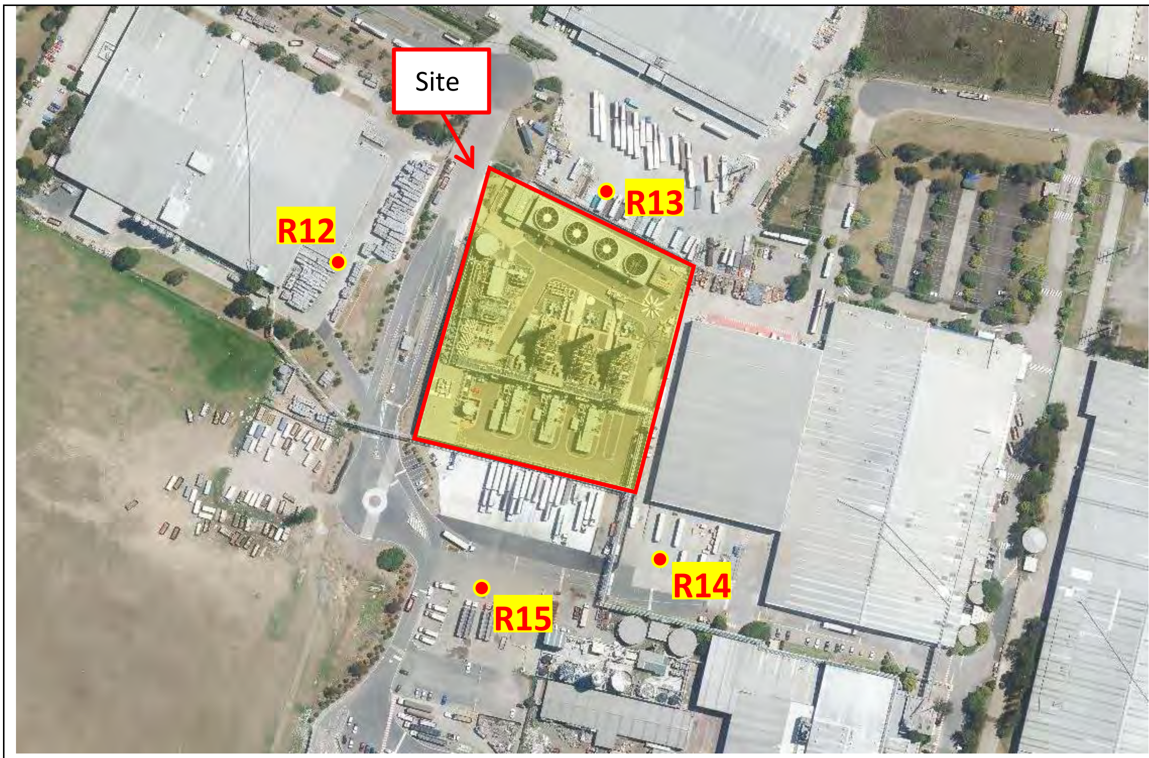
Receptors	Address	Approximate Distance to Proposed Development (m)	Direction	Description
R1	6 Low Street, Smithfield	447	W	Residential
R2	12 Kiola Street, Smithfield	425	WSW	Residential
R3	20 Vineyard Avenue, Smithfield	407	SW	Residential
R4	31 Chisholm Street, Smithfield	310	S	Residential
R5	44 Solo Crescent, Smithfield	336	SSE	Residential
R6	124 Granville Street, Fairfield	494	SE	Residential
R7	126 Fairfield Road, Guilford West	1006	ESE	Residential
R8	111 McCredie Road, Guilford West	848	ENE	Residential
R9	79 Warren Road, Woodpark	1079	NE	Residential
R10	9 Magnolia Street, Greystanes	1564	N	Residential
R11	17 Rhondda Street, Smithfield	1727	NW	Residential
R12	2 Herbert Place, Smithfield	60	W	Industrial
R13	3 Herbert Place, Smithfield	40	N	Industrial
R14	6 Herbert Place, Smithfield/ 158-160 McCredie Road, Smithfield	30	SE	Industrial
R15	6 Herbert Place, Smithfield	60	S	Industrial

Figure 3-1: Nearest Sensitive Residential Receptors

Source: Google Maps® 2014

↑N NOT TO SCALE	LEGEND: Receptor: ● Site: ▭	Benbow Environmental 25-27 Sherwood Street NORTHMEAD NSW 2152

Figure 3-2: Nearest Sensitive Industrial Receptors



Source: Six Maps

↑N Not to scale	LEGEND: Receptor: ● Site: ▭	Benbow Environmental 25-27 Sherwood Street NORTHMEAD NSW 2152

4. 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 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.

4.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

The background noise level measurements were carried out using a Svantek SVAN 957 Precision Sound Level Meter (attended noise monitoring), and three (3) Acoustic Research Laboratories statistical Environmental Noise Logger, type EL-215 and type Ngara (unattended noise monitoring). 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 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
Long-term Unattended	ARL-215	194438	A-weighted Fast Response 15 minute integration period
Long-term Unattended	NGARA	8780AD	A-weighted Fast Response C-weighted Fast Response Wave sampling frequency 48 KHz Logger file Recorded at steps of 100 ms
		8780AE	
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 Location

The environmental noise logger was utilised to measure the existing ambient and background noise levels. Unattended long-term noise monitoring was undertaken from 19th June 2017 to 27th June 2017 at three (3) residential locations. Attended monitoring was undertaken at seven (7) locations. There have been negligible changes to the surrounding acoustic environment since the time of monitoring and the data is considered suitably representative.

The noise logger locations are shown in Figure 4-1 and listed in Table 4-2. Noise logger charts are presented in Attachment 4.

Table 4-2: Noise Monitoring Location

Monitoring Location	Methodology	Address
A	Attended monitoring	Kiola Street St, Smithfield
B	Attended monitoring and unattended monitoring	17 Vineyard Ave, Smithfield (Street Side)
C	Attended monitoring	Vineyard Ave, Smithfield (Prospect Creek Side)
D	Attended monitoring and unattended monitoring	6 Coopers Cres, Smithfield
E	Attended monitoring	31 Solo Cres, Fairfield (Street Side)
F	Attended monitoring	31 Solo Cres, Fairfield (Prospect Creek Side)
G	Attended monitoring and unattended monitoring	16 Iris St, Guildford West
H	Attended monitoring	142 McCredie Road, Smithfield
I	Attended monitoring	162 Warren Road, Smithfield
J	Attended monitoring	162 Warren Road, Smithfield
K	Attended monitoring	162 Warren Road, Smithfield

Figure 4-1: Monitoring Locations

↑N	LEGEND: Site: Noise Monitoring Location ●	Benbow Environmental 25-27 Sherwood Street NORTHMEAD NSW 2152

4.3 MEASURED NOISE LEVELS

4.3.1 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 INP. 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 4-3.

Table 4-3: Unattended Noise Monitoring Results, dB(A)

Monitoring Location	Assessment Background Level ABL (L_{90})			Equivalent Ambient Noise Level L_{eq}		
	Day	Evening	Night	Day	Evening	Night
Location B	42	46	41	55	51	49
Location D	44	46	44	59	50	50
Location G	42	41	36	56	49	47

4.3.2 Short Term Operator 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 4-4.

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_{1}	Comments
Location A Monday 19/06/2017 13:40 Daytime Period	49 dB(A)	46 dB(A)	51 dB(A)	56 dB(A)	Birds < 60 dB(A) Vehicle movements in industrial area audible Traffic < 53 dB(A) Light breeze audible Aeroplane < 54 dB(A) **Vehicle dumping < 51 – Visy site** **Reverse beeper < 46 dB(A) x2** Insects < 47 **Industrial noise audible < 52 dB(A) x2** **Material movements < 50 dB(A) x7** Car ignition < 48 **Industrial hammering < 52 dB(A)** No “industrial hum” contribution obtained due to high background **Estimated LAeq Industrial = 46 dB(A)**
	65 dB(C)	62 dB(C)	67 dB(C)	71 dB(C)	
Location B Monday 19/06/2017 14:14 Daytime Period	49 dB(A)	44 dB(A)	52 dB(A)	58 dB(A)	Aeroplane < 61 dB(A) Power tools (residential) < 61 dB(A) Traffic < 56 dB(A) Birds < 59 dB(A) Truck < 58 dB(A) Light breeze Bins (residential) < 47 dB(A) Car driving into nearby driveway < 49 dB(A) Car door closing < 52 dB(A) **Distant hammering < 47 dB(A) x 4 from industrial site** **Alarm from industrial area < 48 dB(A) (impulse)** **Industrial impulse noise < 49 dB(A)** **Some low frequency rumbling noise was audible from industrial site** Noise dominated by traffic and birds. **Industrial noise barely audible for the majority of the measurement.** **Estimated LAeq Industrial = 40 dB(A)**
	64 dB(C)	60 dB(C)	66 dB(C)	70 dB(C)	

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Location E 19/06/2017 15:18 Daytime Period	50 dB(A)	45 dB(A)	52 dB(A)	61 dB(A)	Birds < 69 dB(A) Distant traffic < 47 dB(A) **Reverse beepers barely audible < 43 dB(A)** Dogs barking < 50 dB(A) Aeroplane < 55 dB(A) Car parking nearby < 54 dB(A) Car door closing < 63 dB(A) Car idling nearby < 52 dB(A) Light wind < 47 dB(A) Distant vehicles < 48 dB(A) Car passing < 67 dB(A) Power tools (residential) < 50 dB(A) Distant siren < 48 dB(A) Car in nearby driveway < 50 dB(A) Many dogs barking < 63 dB(A) House door slamming < 67 dB(A) Noise dominated by traffic and birds **Industrial noise barely audible**
	62 dB(C)	58 dB(C)	65 dB(C)	68 dB(C)	
Location D 19/06/2017 15:40 Daytime Period	53 dB(A)	45 dB(A)	56 dB(A)	65 dB(A)	Birds < 69 dB(A) Light wind < 48 dB(A) **Industrial impulses audible** Aeroplane < 71 dB(A) Distant traffic audible **Industrial noise < 45 dB(A)** **Industrial beeper < 45 dB(A)** **Industrial material movements < 52 dB(A); 51 dB(A); 53 dB(A); 50 dB(A); 52 dB(A); 62 dB(A); 59 dB(A); 61 dB(A); 55 dB(A); 60 dB(A); 59 dB(A); 59 dB(A)** Car passing < 58 dB(A) Garage opening (residential) < 57 dB(A) **Vehicle accelerating – Visy < 60 dB(A)** Noise dominated by bird noise **Estimated LAeq Industrial = 50 dB(A)**
	64 dB(C)	61 dB(C)	66 dB(C)	73 dB(C)	
Location G 19/06/2017 16:21 Daytime Period	50 dB(A)	44 dB(A)	53 dB(A)	59 dB(A)	Birds < 63 dB(A) People talking nearby < 55 dB(A) Distant traffic audible **Industrial movement (impulse) < 51 dB(A) x1** Aeroplane < 58 dB(A) Truck nearby road < 55 dB(A) Car passing < 56 dB(A) **Reverse beepers audible**

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
	65 dB(C)	57 dB(C)	68 dB(C)	75 dB(C)	Cars passing on nearby road ≈ 50 dB(A) Car horn < 68 dB(A) Person shouting nearby < 67 dB(A) Noise dominated by birds and traffic **Industrial noise inaudible for the majority of the measurement** **Estimated LAeq Industrial < 35 dB(A)**
Location A 27/06/2017 15:12 Daytime Period	53 dB(A)	47 dB(A)	55 dB(A)	65 dB(A)	Birds < 73 dB(A) **Constant industrial noise < 48 dB(A)** Constant traffic noise < 48 dB(A) **Industrial impulse noise < 51 dB(A) (15:13:35)** Insects audible **Estimated LAeq Industrial < 35 dB(A)** Distant dogs barking audible Trucks on nearby highway < 51 dB(A) **Industrial material movements < 53 dB(A) (15:17:10)** Reverse beepers barely audible Aeroplane < 67 dB(A) Bike passing < 55 dB(A) Truck horn distant < 54 dB(A) **Industrial impulse noise < 49 dB(A) (15:23:10)** **Industrial impulse noise < 53 dB(A) (15:23:35)** Dog < 58 dB(A) **Industrial impulse noise < 51 dB(A) (15:26:45)** **Estimated LAeq Industrial <48 dB(A)**
	65 dB(C)	62 dB(C)	67 dB(C)	72 dB(C)	
Location C 27/06/2017 15:49 Daytime Period	53 dB(A)	49 dB(A)	55 dB(A)	62 dB(A)	Birds < 58 dB(A) – dominated start of measurement Distant traffic audible Creek audible **Industrial noise < 56 dB(A) (15:50:25)** Aeroplane < 59 (15:50:30 – 15:51:00) Motorised bike passing on footpath < 71 dB(A) **Industrial noise ≈ 51 (15:51:25 -15:51:40) – minimal bird noise**

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
	67 dB(C)	63 dB(C)	69 dB(C)	75 dB(C)	**Industrial noise ≈ 53 (15:52:00-15:52:40) – 4x dogs barking at 54 dB(A) has been excluded from industrial noise level** **Industrial noise ≈ 51 (15:53:20-15:53:50) – minimal bird noise** **Reverse beeping (broadband) < 53 dB(A)** **Industrial noise typically ≈ 49-51 dB(A)** **Industrial impulse noise < 68 dB(A) (15:59:10)** **Industrial impulse noise < 65 dB(A) (16:00:10)** **Industrial impulse noise < 60 dB(A) (16:00:25)** Aeroplane < 56 (16:00:25 – 16:01:50) **Industrial impulse noise < 66 dB(A) (16:02:15)** **Noise dominated by industrial noise and bird noise** **Estimated LAeq Industrial = 50 dB(A)**
Location E 27/06/2017 17:14 Daytime Period	49 dB(A)	45 dB(A)	50 dB(A)	58 dB(A)	Car passing < 68 dB(A) Distant traffic < 50 dB(A) Aeroplane < 51 dB(A) **Industrial noise constant ≈ 47 – 48 dB(A) (nearby stack fan)** **Industrial impulse noise < 48 dB(A) (17:16:10,17:16:20)** Insects audible **Industrial impulse < 50 dB(A) (17:17:40)** Distant noise vehicle < 53 dB(A) Car door slamming < 54 dB(A) House door slamming < 53 dB(A) Bird (Crow) < 61 dB(A) Distant barking <48 dB(A) Reverse beeper audible Distant horn < 52 dB(A) Dogs barking < 55 dB(A) Car ignition < 52 dB(A) Car accelerating nearby < 61 dB(A) Distant fireworks < 49 dB(A) **Noise dominated by constant industrial noise** **Estimated LAeq Industrial 47 dB(A)**
	64 dB(C)	60 dB(C)	66 dB(C)	71 dB(C)	

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Location D 27/06/2017 17:40 Daytime Period	58 dB(A)	48 dB(A)	52 dB(A)	62 dB(A)	Distant road traffic noise < 48 dB(A) **Industrial noise typically ≈ 46 – 49 dB(A)** **Industrial impulse noise < 56 dB(A) (17:41:00)** **Industrial impulse noise < 51 dB(A) (17:41:30)** **Industrial impulse noise < 51 dB(A) (17:41:40)** **Industrial impulse noise < 55 dB(A) (17:41:50)** **Industrial impulse noise < 53 dB(A) (17:42:10)** Distant car revving < 50 dB(A) Aeroplane < 58 dB(A) **Industrial impulses < 56 dB(A) (17:43:20-17:44:10)** **Reverse beepers audible**
	69 dB(C)	61 dB(C)	67 dB(C)	76 dB(C)	Distant vehicle < 53 dB(A) House door slamming < 54 dB(A) (17:45:25) **Industrial impulse noise < 66 dB(A) (17:46:05)** Car passing < 89 dB(A) **Industrial impulse noise < 68 dB(A) (17:49:10)** **Industrial impule noise < 53 dB(A) (17:49:40-17:49:45)** Elevated noise due to distant loud vehicle – 17:50-17:51) **Estimated LAeq Industrial 50 dB(A)**
Location G 27/06/2017 18:42 Evening Period	54 dB(A)	40 dB(A)	48 dB(A)	65 dB(A)	Dogs barking < 75 dB(A) Distant traffic < 43 dB(A) Train boom gates noise < 43 dB(A) Distant aeroplane noise < 42 dB(A) Vehicles passing on nearby road < 48 dB(A) Aeroplane < 57 dB(A) Baby crying < 42 dB(A)
	61 dB(C)	54 dB(C)	62 dB(C)	73 dB(C)	Truck passing on nearby road < 59 dB(A) Car passing < 49 dB(A) Distant motorbike revving < 49 dB(A) Car door closing nearby < 49 dB(A) Hammering (residential) < 42 dB(A) **Distant reverse beepers barely audible** **No industrial noise audible LAeq < 35 dB(A)**

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Location A 27/06/2017 19:10 Evening Period	50 dB(A)	48 dB(A)	51 dB(A)	55 dB(A)	Traffic < 50 dB(A); ≈ 48-49 dB(A) constant Traffic is dominant noise source **Industrial site hum is barely audible due to traffic noise** **Industrial impulse noise < 52 dB(A) (19:11:20)** **Industrial impulse noise < 50 dB(A) (19:11:45)** **Industrial impulse noise < 51 dB(A) (19:11:55)** **Industrial impulse noise < 50 dB(A) (19:12:05)** Aeroplane distant < 48 dB(A) (19:12-19:13) **Industrial impulse noise < 51 dB(A) (19:12:50)** **Industrial impulse noise < 51 dB(A) (19:13:10)** **Industrial impulse noise < 53 dB(A) (19:13:20)** **Industrial impulse noise < 53 dB(A) (19:13:30)** **Industrial impulse noise < 51 dB(A) (19:13:40)** **Industrial impulse noise < 52 dB(A) (19:14:00)** Elevated traffic levels < 54 dB(A) (19:14:45-19:15:30) **Industrial impulse noise < 55 dB(A) (19:15:45)** **Industrial impulse noise < 50 dB(A) (19:16:10)** **Industrial impulse noise < 49 dB(A) (19:19:40)** **Industrial impulse noise < 50 dB(A) (19:23:00)** **Industrial impulse noise < 48 dB(A) (19:23:35)** **Estimated LAeq Industrial 46 dB(A)**
	65 dB(C)	61 dB(C)	62 dB(C)	73 dB(C)	
Location B 27/06/2017 19:37 Evening Period	49 dB(A)	46 dB(A)	50 dB(A)	57 dB(A)	Car passing on nearby road < 55 dB(A) Traffic ≈ 48 dB(A) **Industrial Impulse Noise < 47 dB(A) (19:37:25)** **Industrial Impulse Noise < 49 dB(A) (19:38:40)** **Industrial Impulse Noise < 48 dB(A) (19:38:30)** Person coughing < 49 dB(A) Car horn < 52 dB(A) People talking < 49 dB(A) Car door slamming < 58 dB(A) Person sneezing < 66 dB(A) Person shouting < 63 dB(A) Aeroplane < 54 dB(A) Bats < 49 dB(A) People laughing nearby < 55 dB(A) Car pulling out of drive < 61 dB(A) Siren < 59 dB(A) **Industrial noise barely audible for the majority of the measurement.** **Estimated LAeq Industrial = 40 dB(A)**
	61 dB(C)	58 dB(C)	63 dB(C)	67 dB(C)	

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Location C 27/06/2017 19:56 Evening Period	49 dB(A) 65 dB(C)	47 dB(A) 61 dB(C)	51 dB(A) 68 dB(C)	53 dB(A) 71 dB(C)	Traffic < 53 dB(A); < 47-48 dB(A) constant Creek audible Site noise audible (constant) < 49 Bats < 57 dB(A) **Industrial impulse noises < 55 dB(A) (19:58:05-19:58:15)** **Industrial noise dominant < 56 dB(A); ≈ 48 dB(A) (19:58:45-19:59:25)** **Industrial noise dominant < 56 dB(A); ≈ 47 dB(A) (19:59:45-20:01:05)** **Industrial noise dominant < 53 dB(A); ≈ 47 dB(A) (20:01:35-20:02:20)** **Industrial noise dominant < 50 dB(A); ≈ 47 dB(A) (20:02:30-20:02:55)** Aeroplane (20:02:55-20:05:35) **Industrial impulse noise < 58 dB(A) (20:03:40)** **Reverse alarm (broadband) < 51 dB(A) (duration 50 sec total)** **Industrial impact noise < 50 dB(A) (20:05:35)** **Industrial impact noise < 51 dB(A) (20:07:05)** **Industrial impact noises < 51 dB(A) (20:09:45-20:09:55)** **Estimated LAeq Industrial = 47 dB(A)**
Location D 27/06/2017 20:28 Evening Period	52 dB(A)	48 dB(A)	51 dB(A)	59 dB(A)	**Industrial noise dominant ≈ 48 – 49 dB(A) (20:28:45-20:29:05)** Distant revving < 50 dB(A) (20:29:25) **Industrial noise dominant ≈ 48 dB(A) (20:29:40 - 20:30:46)** Car revving < 53 dB(A) (20:30:55) Distant traffic ≈ 47 dB(A) **Industrial noise dominant ≈ 48 dB(A) (20:31:10 - 20:32:55)** **Reverse alarm (broadband) ≈ 49-50 dB(A) (total duration 1 min)**

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_{1}	Comments
	64 dB(C)	61 dB(C)	65 dB(C)	68 dB(C)	House door slamming < 63 dB(A) Residential bin movements < 70 dB(A) Car door slamming < 63 dB(A) **Industrial noise dominant ≈ 48 dB(A) (20:34:40 - 20:35:00)** Car ignition < 52 dB(A) Bats < 57 dB(A) Aeroplane < 53 dB(A) **Industrial impulse noise < 58 dB(A)** Car passing < 62 dB(A) **Industrial noise dominant ≈ 48 dB(A) (20:38:50 20:43:25)** **Estimated LAeq Industrial = 50 dB(A)**
Location E 27/06/2017 20:58 Evening Period	49 dB(A)	46 dB(A)	50 dB(A)	56 dB(A)	Traffic < 52 dB(A); ≈ 46 - 47 dB(A) Car parking nearby < 52 dB(A) Car door < 53 dB(A) **Industrial hum ≈ 46 – 47 dB(A)** Distant dogs barking audible Bats audible **Industrial impulse noise < 61 dB(A) (21:03:00)** Aeroplane < 55 dB(A) Nearby car immobiliser < 62 dB(A) Distant car revving (very loud) < 57 dB(A) Car ignition < 52 dB(A) **Industrial impulse noise <53 dB(A) (21:07:15)** Car manoeuvring nearby < 50 dB(A) Car passing < 67 dB(A) House door < 57 dB(A) **Estimated LAeq Industrial = 47 dB(A)**
	63 dB(C)	60 dB(C)	65 dB(C)	68 dB(C)	
Location F 27/06/2017 21:18 Evening Period	52 dB(A)	51 dB(A)	53 dB(A)	54 dB(A)	**Industrial noise dominant ≈ 52 dB(A) – constant and clear – likely due to industrial fan** Distant traffic audible Impulse noise (truck distant) < 54 dB(A) **Industrial impulse noise < 55 dB(A)** **Estimated LAeq Industrial = 52 dB(A)**
	65 dB(C)	63 dB(C)	67 dB(C)	69 dB(C)	

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Location G 27/06/2017 22:00 Night Period	44 dB(A)	40 dB(A)	46 dB(A)	52 dB(A)	Dogs barking < 51 dB(A) Vehicles on nearby road < 48 dB(A) Truck on nearby road < 55 dB(A) Distant traffic < 41 dB(A) Insects barely audible Distant motorbike revving < 53 dB(A) Residential noise < 44 dB(A) Car passing < 51 dB(A) House door < 46 dB(A)
	60 dB(C)	54 dB(C)	61 dB(C)	71 dB(C)	High frequency metal on metal noise (residential) < 48 dB(A) **Reverse beepers audible < 41 (duration less than 10 secs)** Distant aeroplane audible **Noise of dumping glass < 45 dB(A) x2** **Industrial noise inaudible majority of the measurement LAeq < 35 dB(A)**
Location E 27/06/2017 22:30 Night Period	48 dB(A)	46 dB(A)	49 dB(A)	51 dB(A)	Loud vehicle revving < 55 dB(A) **Industrial noise dominant, constant ≈ 46 - 47 dB(A)** Traffic < 51 dB(A); ≈ 46 - 47 dB(A)
	61 dB(C)	59 dB(C)	63 dB(C)	66 dB(C)	**Industrial impulse noises 51 - 58 dB(A)** Car horn < 55 dB(A) **Reverse beepers barely audible** **Estimated LAeq Industrial = 47 dB(A)**
Location F 27/06/2017 22:49 Night Period	52 dB(A)	51 dB(A)	53 dB(A)	54 dB(A)	**Industrial noise dominant ≈ 52 dB(A) – constant and clear – likely due to industrial fan** Distant traffic barely audible
	65 dB(C)	63 dB(C)	67 dB(C)	69 dB(C)	Insects barely audible **Industrial impulse noises 55 - 60 dB(A)** **Estimated LAeq Industrial = 52 dB(A)**
Location D 27/06/2017 23:13 Night Period	49 dB(A)	47 dB(A)	50 dB(A)	52 dB(A)	Reverse beeper audible Distant loud revving < 53 dB(A) (duration 2.5 mins) **Industrial noise constant ≈ 48 dB(A)** **Industrial impulse noises 51 – 56 dB(A)**
	63 dB(C)	61 dB(C)	65 dB(C)	67 dB(C)	Car passing < 59 dB(A) Bats < 57 dB(A) **Estimated LAeq Industrial = 49 dB(A)**

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_1	Comments
Location B 27/06/2017 23:37 Night Period	46 dB(A)	42 dB(A)	47 dB(A)	56 dB(A)	Car passing on nearby road < 54 dB(A) Distant traffic ≈ 43 dB(A) Distant traffic revving < 45 dB(A) Car passing < 63 dB(A) Car door slamming < 58 dB(A) **Industrial impulse noise 44 dB(A) x3** **Industrial impulse noise 46 dB(A) x1** **Industrial impulse noise 67 dB(A) x1** Truck passing on nearby road < 52 dB(A) Bats < 68 dB(A) Reverse alarm (broadband) < 42 dB(A) **Estimated LAeq Industrial = 40 dB(A)**
	60 dB(C)	56 dB(C)	62 dB(C)	69 dB(C)	
Location C 27/06/2017 23:56 Night Period	48 dB(A)	47 dB(A)	50 dB(A)	52 dB(A)	Noise dominated by industrial noise ≈ 47-48 dB(A) Reverse alarm (broadband) < 51 dB(A) **Industrial material movements < 51 dB(A)** Distant traffic < 50 dB(A), typically <47 dB(A) **Industrial impulse noise 51 – 62 dB(A)** **Estimated LAeq Industrial = 47 dB(A)**
	63 dB(C)	60 dB(C)	65 dB(C)	70 dB(C)	
Location A 28/06/2017 00:22 Night Period	47 dB(A)	45 dB(A)	49 dB(A)	51 dB(A)	**Industrial noise constant ≈ 45-47 dB(A)** **Industrial impulse noise 46 – 57 dB(A)** Distant traffic < 50 dB(A), typically ≈ 48 dB(A) **Reverse beepers audible** **Reverse alarm (broadband) audible** **Estimated LAeq Industrial = 46 dB(A)**
	62 dB(C)	59 dB(C)	64 dB(C)	68 dB(C)	
Location H 03/07/2017 16:13 Day Period	57 dB(A)	56 dB(A)	58 dB(A)	59 dB(A)	Birds < 61 dB(A) Noise dominated by constant industrial noise from nearby site **Estimated LAeq Industrial = 57 dB(A)**
	73 dB(C)	70 dB(C)	75 dB(C)	78 dB(C)	
Location I 03/07/2017 16:28 Day Period	56 dB(A)	50 dB(A)	55 dB(A)	69 dB(A)	Birds dominated measurement < 72 dB(A) **Industrial noise audible** **Industrial impulse noise < 54 dB(A)** **Estimated LAeq Industrial = 51 dB(A)**
	66 dB(C)	64 dB(C)	68 dB(C)	70 dB(C)	
Location J 03/07/2017 16:38 Day Period	56 dB(A)	50 dB(A)	58 dB(A)	68 dB(A)	Birds dominated measurement < 76 dB(A) Aeroplane audible Constant industrial noise audible Truck manoeuvring on industrial site < 54 dB(A) **Industrial impulse noise < 71 dB(A)** **Estimated LAeq Industrial = 51 dB(A)**
	70 dB(C)	65 dB(C)	71 dB(C)	81 dB(C)	

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

Location & Date/Time	L_{eq}	L_{90}	L_{10}	L_{1}	Comments
Location K 03/07/2017 16:49 Day Period	56 dB(A)	54 dB(A)	57 dB(A)	60 dB(A)	Road traffic noise < 60 dB(A) Birds < 60 dB(A) **Industrial impulse noise < 61 dB(A)** **Industrial reverse alarm (broadband) audible (duration < 15 seconds)** **Industrial noise, road traffic noise and bird noise constant throughout measurement.** **Estimated LAeq Industrial = 51 dB(A)**
	69 dB(C)	67 dB(C)	72 dB(C)	75 dB(C)	
Location J 03/07/2017 17:09 Day Period	52 dB(A)	48 dB(A)	53 dB(A)	60 dB(A)	Bird noise dominant until 17:15 where it becomes minimal Reverse alarm (broadband) < 56 dB(A) Road traffic noise < 59 dB(A) Birds < 57 dB(A) **Industrial impulse noises < 74 dB(A)** **Estimated LAeq Industrial = 51 dB(A)**
	69 dB(C)	65 dB(C)	70 dB(C)	78 dB(C)	
Location K 03/07/2017 17:35 Day Period	55 dB(A)	53 dB(A)	56 dB(A)	59 dB(A)	Birds < 55 dB(A) Police siren < 56 dB(A) Aeroplane < 55 dB(A) duration 2.5 minutes **Industrial impulse noise < 72 dB(A) (range 54-72dB(A))** Reverse alarm (broadband) audible Road traffic noise < 57 dB(A) **Constant industrial noise audible** **Estimated LAeq Industrial = 51 dB(A)**
	69 dB(C)	66 dB(C)	71 dB(C)	74 dB(C)	
Location H 03/07/2017 19:04 Evening Period	57 dB(A)	56 dB(A)	58 dB(A)	59 dB(A)	**Noise from industrial site nearby constant and dominant** Distant revving audible Aeroplane audible **Estimated LAeq Industrial = 57 dB(A)**
	72 dB(C)	69 dB(C)	74 dB(C)	76 dB(C)	
Location I 03/07/2017 19:24 Evening Period	51 dB(A)	48 dB(A)	52 dB(A)	60 dB(A)	Road traffic noise < 56 dB(A) **Reverse beepers < 49 dB(A)** **Industrial impulse noise <54 dB(A)** Aeroplane audible **Estimated LAeq Industrial = 50 dB(A)**
	65 dB(C)	62 dB(C)	68 dB(C)	72 dB(C)	

4.4 JUSTIFICATION FOR THE USE OF 2017 NOISE DATA

Noise data use for 2017 is valid for this noise assessment as there has been little to no change in the surrounding acoustic environment in the area since 2017. Noise from the Cumberland highway and the Visy recycling centre remain the dominant source of background noise for the most impacted residential receptors. Furthermore, as the most critical noise criteria is the night criteria, which is evidently governed by the amenity criteria as per the Noise Policy for Industry 2017 (see section 6.2.5) changes in the background between 2017 to 2023 are unlikely to alter the nighttime noise limits, and thus would not alter the outcomes of this assessment.

5. METEOROLOGICAL FACTORS

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.

To determine the most representative year, climate data for last 5 years (2018-2022) is compared against the overall average of the how long the BOM station has been in operation. Monthly and annual data compared includes:

- Mean maximum temperature;
- Mean minimum temperature;
- Mean rainfall;
- Mean daily wind run; and
- Mean solar exposure.

The year closest to the long-term average is chosen and assessed as the most representative year.

A site-representative meteorological data file was obtained from the Bureau of Meteorology (BOM) for the Horsley Park (AWS ID 067119). In this Section, an analysis of the 2020 weather data has been conducted to establish whether significant winds are characteristic of the area.

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.

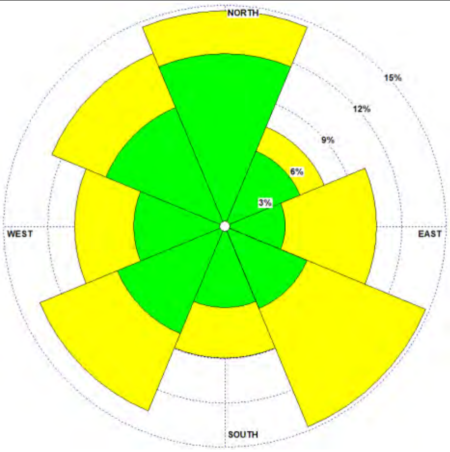
The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

5.1.2 Local Wind Trends

Seasonal wind rose plots for this site utilising the Horsley Park AWS data have been included in Figure 5-1 to Figure 5-3.

Figure 5-1: Wind Rose Plots – BOM Horsley Park ID 067119 – 2020 – Day time

All Seasons

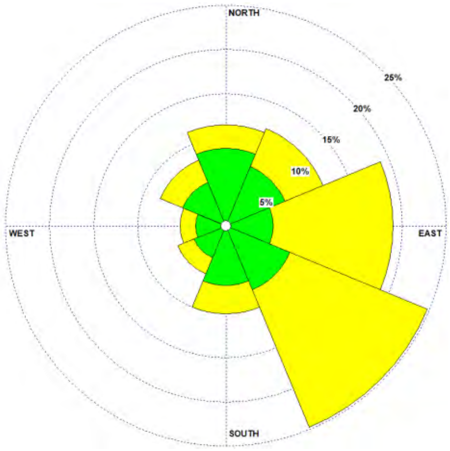


Average Wind Speed: 2.55 m/s

Calms Frequencies: 7.38%

Axis Frequencies: 3%, 6%, 9%, 12%, 15%

Summer Season (December – February)

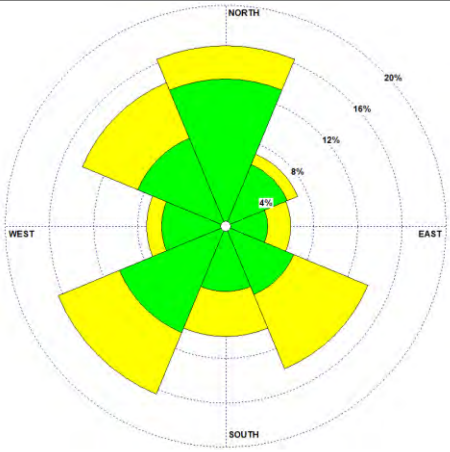


Average Wind Speed: 2.95 m/s

Calms Frequencies: 3.75%

Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)

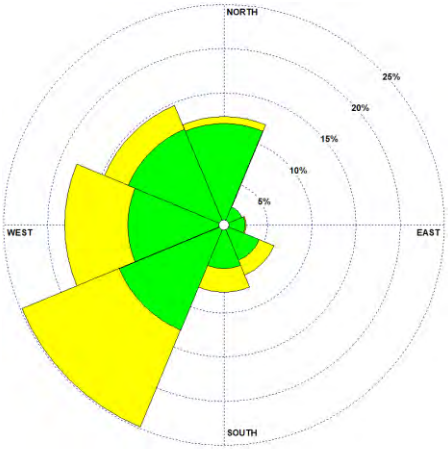


Average Wind Speed: 2.33 m/s

Calms Frequencies: 9.24%

Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Winter Season (June – August)

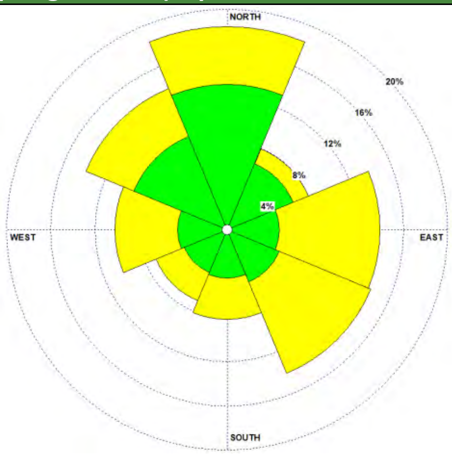


Average Wind Speed: 2.19 m/s

Calms Frequencies: 11.68%

Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Spring Season (September – November)



Average Wind Speed: 2.72 m/s

Calms Frequencies: 4.76%

Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Legend

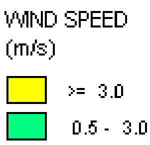
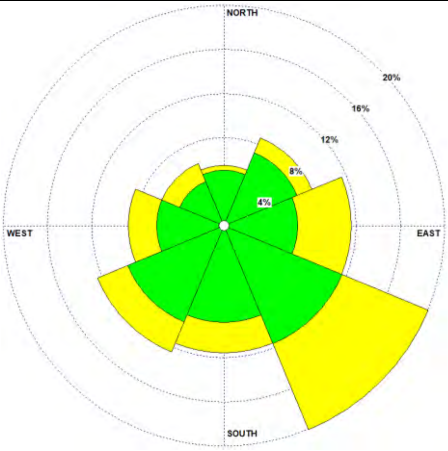


Figure 5-2: Wind Rose Plots – BOM Horsley Park AWS ID 067119 – 2020 – Evening time

All Seasons

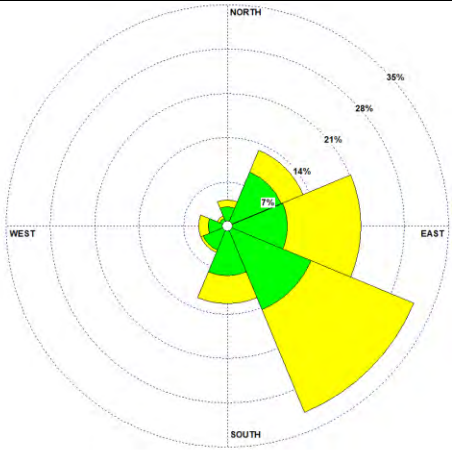


Average Wind Speed: 2.00 m/s

Calms Frequencies: 15.36%

Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Summer Season (December – February)

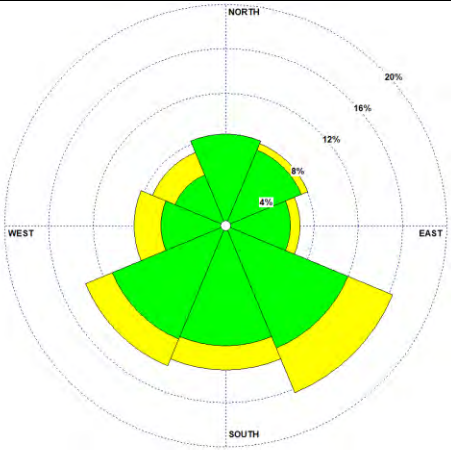


Average Wind Speed: 2.60 m/s

Calms Frequencies: 6.59%

Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Autumn Season (March – May)

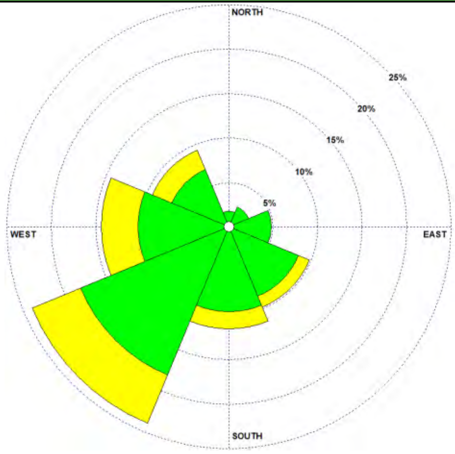


Average Wind Speed: 1.72 m/s

Calms Frequencies: 18.48%

Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Winter Season (June – August)

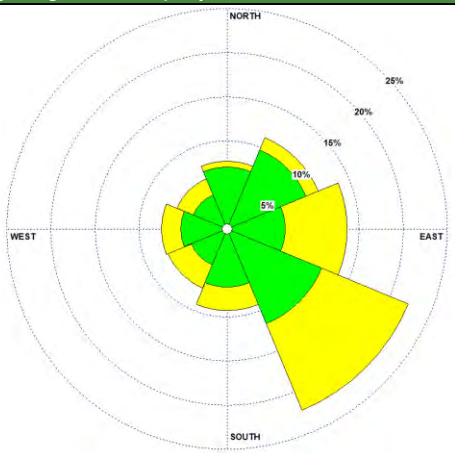


Average Wind Speed: 1.57 m/s

Calms Frequencies: 22.17%

Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Spring Season (September – November)



Average Wind Speed: 2.12 m/s

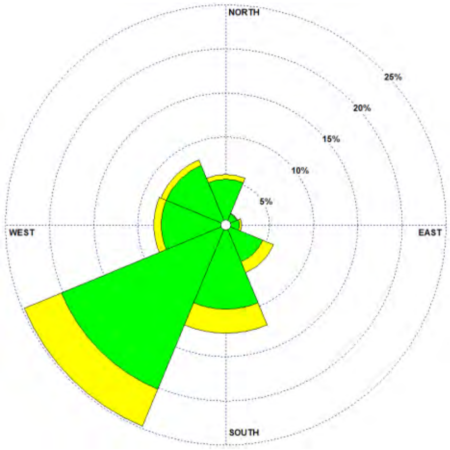
Calms Frequencies: 14.07%

Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Legend

Figure 5-3: Wind Rose Plots – BOM Horsley Park ID 067119 – 2020 – Night time

All Seasons

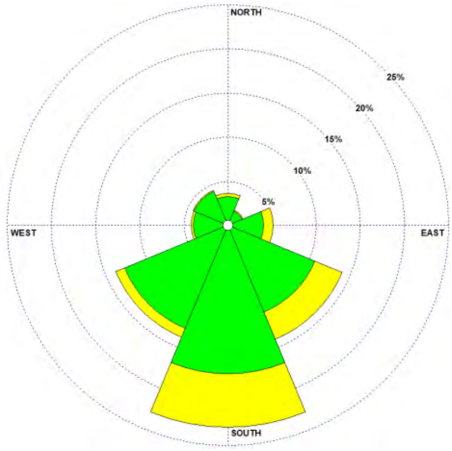


Average Wind Speed: 1.29 m/s

Calms Frequencies: 31.61%

Axis Frequencies: : 5%, 10%, 15%, 20%, 25%

Summer Season (December – February)

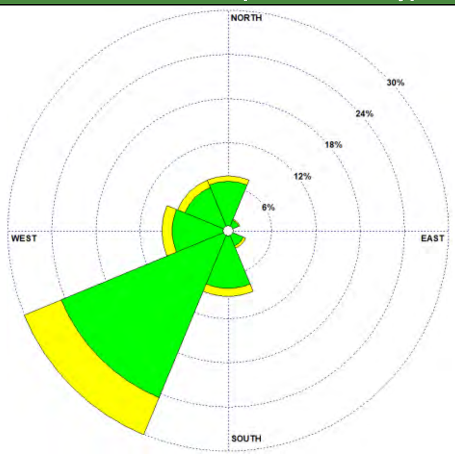


Average Wind Speed: 1.36 m/s

Calms Frequencies: 30.33%

Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)

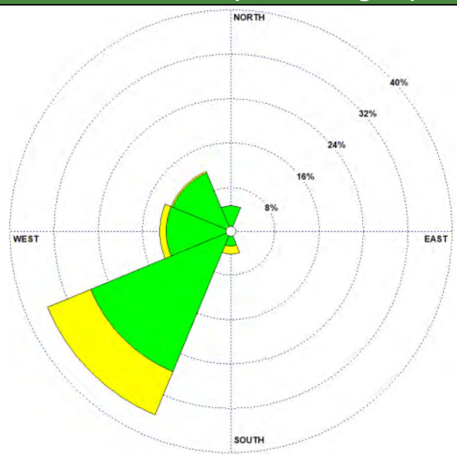


Average Wind Speed: 1.30 m/s

Calms Frequencies: 32.07%

Axis Frequencies: 6%, 12%, 18%, 24%, 30%

Winter Season (June – August)

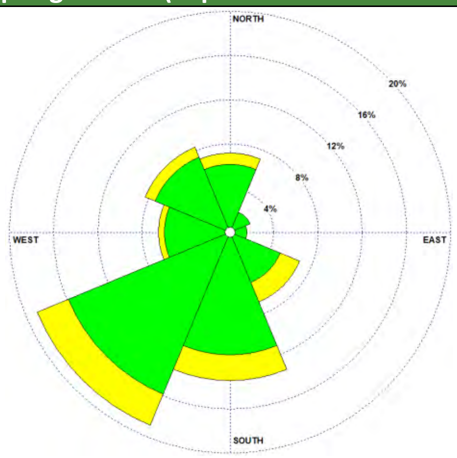


Average Wind Speed: 1.30 m/s

Calms Frequencies: 30.11%

Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Spring Season (September – November)

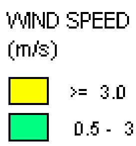


Average Wind Speed: 1.19 m/s

Calms Frequencies: 33.96%

Axis Frequencies: 4%, 8%, 12%, 16%, 20%

Legend



Appendix D2 of the Noise Policy for Industry (EPA, 2017), refers to utilising the Noise Enhancing Wind Analysis (NEWA) program on the NSW EPA website to determine the significance of source-to-receiver winds.

Table 5-1 below contains the noise wind component analysis from the NEWA software. Wind speeds are taken up to 3 m/s and wind direction is taken from source-to-receiver, plus and minus 45 degrees, as per appendix D2 of the Noise Policy for Industry.

It can be seen from Table 5-1 that there are twelve instances, where more than 30% of wind speeds are less than 3 m/s in the plus and minus 45 degree arc from source to receiver.

Table 5-1: Noise Wind Component Analysis 2020 Horsley Park

	Day				Evening				Night			
Receiver	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
R1	16.7	12	7.3	15.5	25.8	10.3	3.3	16.2	5.9	1.3	0	2.7
R2	18	14	6.1	16.3	22.5	10.1	2.4	16.2	3.8	2.2	0.2	2.9
R3	20.4	20.1	11	21.9	22	11.4	2.4	17.6	4	5.1	1.1	4.9
R4	19.5	23.1	16.8	23	6.9	12	6	13.7	6	9.7	9.3	9.6
R5	15.9	24.4	21.2	22.2	5.5	13.3	10.6	13.5	7.1	12.3	14.9	13.2
R6	12.5	20.2	24.3	21.4	4.9	13.3	16.8	14.3	8.1	12.8	19.2	14.3
R7	7.5	13.1	25.6	12.4	5.2	15.5	23.9	11.3	8.1	14.7	25.8	13.6
R8	7	14.1	26.2	10.4	6	19.8	33.7	14.3	10.4	29.5	40.5	19
R9	7.6	15.2	21.9	9.1	10.2	27.7	33.2	10.4	26.3	34.8	33.6	27.8
R10	14	17.4	16.9	9.2	20.3	25.8	22.8	19.8	32.5	26.3	18.1	26.6
R11	16.3	14.2	10.6	14	34.6	12.5	6	21.2	11.7	1.7	0.2	5.5
R12	18.1	15.2	11.1	13.2	33.5	14.1	7.1	19.2	16.9	3.4	0.6	7.3
R13	9.3	16.5	19.6	8.1	15.1	28	32.1	13.5	31.3	33.7	31.2	28.3
R14	12.9	20.5	24.5	21.5	4.9	13.3	16.8	14.3	8.1	13	18.6	14
R15	19.7	22.7	14.8	22.8	9.9	12.5	3.8	14.6	5.4	8.8	7.4	8.3

Noise enhancing meteorological conditions occur for 30% or more of the period and season

5.2 Temperature Inversions

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

Temperature inversion conditions would be best associated with F-class stability conditions – generally associated with still/light winds and clear skies during the night time or early morning period (these are referred to as stable atmospheric conditions).

The analysis conducted on the 2020 weather data highlighted that during winter 27.68% of the nights presented temperature inversion conditions.

5.2.1 Weather Conditions Considered in the Assessment

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

- Neutral Weather Conditions.
- Noise enhancing wind-affected weather conditions

Details of the considered meteorological conditions have been displayed in Table 5-2.

Table 5-2: Meteorological Conditions Assessed in Noise Propagation Modelling

Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receiver	Applicability
Neutral	10 °C	70%	0 m/s	-	No	All	All periods
Gradient Flow	10 °C	70%	3 m/s	Source to receiver	No	R8-R13*	Evening & Night

*Note R13 is not open during evening or night and therefore wind conditions are not assessed.

6. CURRENT LEGISLATION AND GUIDELINES

6.1 EXISTING EPL REQUIREMENTS

The site is currently required to satisfy specific NSW EPA requirements, as outlined in the site's Environment Protection Licence (Licence no. 5701):

L4 Noise Limits

L4.1 Noise from the premises must not exceed:
a) An LA10 (15 minute) noise emission of 48 dB(A) between 0700 to 2200 Monday to Friday, and 0700 to 1230 Saturdays; and
b) An LA10 (15 minute) noise emission of 43 dB(A) at all other times, except as expressly provided by this licence.

L4.2 Noise from the premises must not exceed:
a) An LA10 (15 minute) noise emission of 48 dB(A) between 0700 to 2200 Monday to Friday, and 0700 to 1230 Saturdays; and
b) An LA10 (15 minute) noise emission of 43 dB(A) at all other times, except as expressly provided by this licence.

L4.3 Noise from the premises must not exceed:
a) An LA10 (15 minute) noise emission of 48 dB(A) between 0700 to 2200 Monday to Friday, and 0700 to 1230 Saturdays; and
b) An LA10 (15 minute) noise emission of 43 dB(A) at all other times, except as expressly provided by this licence.

Table 6-1: Mod 2 Noise Limits

Location	Day 7am to 10pm Monday to Friday and 7am to 12:30pm Saturday	All other times
	LA10(15 minutes)	LA10(15 minutes)
All residential receivers	48	43

The EPL will need to be updated when approval is obtained as the criteria is no longer in line with the latest NSW noise guidelines, (Noise Policy for Industry 2017).

6.2 NSW EPA NOISE POLICY FOR INDUSTRY

6.2.1 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.

6.2.2 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 receiver.

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.

6.2.3 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 6-3. The **urban category** has been selected for the residential noise amenity criteria to match the characteristics of the area.

Industrial Interface

As defined by the Noise Policy for Industry 2017 *industrial interface – an area that is in close proximity to existing industrial premises and that extends out to a point where the existing industrial noise from the source has fallen by 5 dB or an area defined in a planning instrument. Beyond this region the amenity noise level for the applicable category applies. This category may be used only for existing situations (further explanation on how this category applies is outlined in Section 2.7)*.

The following table presents a summary of industrial contribution of the measurements taken at the boundary to the industrial area and the corresponding residential area. Locations are shown in Figure 4-1 and details of operated attended noise monitoring is provided in Table 4-4.

Table 6-2: Industrial Interface

Time Period	Industrial Boundary Location	Residential boundary location	Industrial Boundary Industrial LAeq(15min) Contribution	Residential Boundary Industrial Contribution Laeq(15min)	Industrial Interface Applicable? Y/N
Day	K	A	51	46	Y
Day	J	C	51	50	Y
Day	I	D	51	50	Y
Evening	I	D	50	50	Y
Evening	H	F	57	52	Y

For developments of a limited nature such as an extension to existing process or plant, or replacement of part of an existing process or plant with new technology, the industrial interface assessment applies. This results in adding 5 dB(A) to recommended noise amenity area.

Based on the attended measurements taken along the boundary of the industrial area and at the nearest residential receptors; the urban industrial interface is present for all residential properties facing the industrial area. Any residential properties that receive acoustic shielding from a wall/fence on their boundary between them and the industrial area are not considered within the industrial interface. Therefore, R2 and R4 are considered industrial interface receptors.

Table 6-3: Amenity noise levels.

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} dB(A) Recommended amenity noise level
Residential	Urban (with industrial interface)	Day	65
		Evening	55
		Night	50
Residential	Urban	Day	60
		Evening	50
		Night	45
Industrial Premises	All	When in use	70

Source: Table 2.2 and Section 2.6, 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.

6.2.4 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.

6.2.5 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 6-4.

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 receivers.

Table 6-4: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receiver	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 $L_{Aeq\ 15\ minute}$[1]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
R1	Urban	Day	42	**47**	60	58	**47**	-
		Evening	42[2]	**47**	50	48	**47**	-
		Night	41	46	45	**43**	**43**	**56**
R2	Urban – Industrial Interface	Day	42	**47**	65	63	**47**	-
		Evening	42[2]	**47**	55	53	**47**	-
		Night	41	**46**	50	48	**46**	**56**
R3	Urban	Day	42	**47**	60	55	**47**	-
		Evening	42[2]	**47**	50	48	**47**	-
		Night	41	46	45	**43**	**43**	**56**
R4	Urban – Industrial Interface	Day	44	**49**	65	63	**49**	-
		Evening	44[2]	**49**	55	53	**49**	-
		Night	44	49	50	**48**	**48**	**59**
R5	Urban	Day	44	**49**	60	58	**49**	-
		Evening	44[2]	49	50	**48**	**48**	-
		Night	44	49	45	**43**	**43**	**59**
R6	Urban	Day	44	**49**	60	58	**49**	-
		Evening	44[2]	49	50	**48**	**48**	-
		Night	44	49	45	**43**	**43**	**59**
R7-R11	Urban	Day	42	**47**	60	58	**47**	-
		Evening	41	**46**	50	48	**46**	-
		Night	36	**41**	45	43	**41**	**52**
R12-R15	Industrial	When in use	-	-	70	70	**68**	-

Notes:
1) 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) As per the Noise Policy for Industry section 2.3 the project intrusiveness noise level for evening be set at no greater than the project intrusiveness noise level for daytime.
3) Values in bold are those adopted as the applicable criteria

6.2.6 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's existing peaking plant, this has been addressed cumulatively with the BESS facility. Further details to assess low frequency noise are described in Fact Sheet C of the Noise Policy for Industry, summarised below.

Fact Sheet C describes tonality as noise containing a prominent frequency and characterised by a definite pitch. This means that tonality is the emission of noise within a single octave band frequency. The same fact sheet describes intermittency as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB(A). Neither of these apply to the proposed development.

Table 6-5: 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-third 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-third 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.

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 6-6: 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)

6.3 NSW EPA Road Noise Policy

6.3.1 Introduction

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.

6.3.2 Road Category

The residents expected to be most affected by road traffic noise impacts from the site are located along the Cumberland Highway. The Cumberland Highway is a Classified Highway, Gazetted Road Number 13 in the NSW Schedule of Classified Roads and unclassified Regional Roads. Based on the RNP road classification description, the Cumberland Highway would be classified as an 'Arterial' Road.

6.3.3 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 to the Cumberland Highway are shown in Table 6-7.

Table 6-7: 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)
Arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/ sub-arterial roads generated by land use developments	$L_{Aeq\ (15\ hour)}$ 60 dB (external)	$L_{Aeq\ (9\ hour)}$ 55 dB (external)

* measured at 1 m from a building façade.

The noise level descriptor that has been adopted by the NSW RNP for use with the above criteria is the L_{Aeq}.

6.3.4 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 relative 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.

Table 6 of the RNP outlines the relative increase criteria for residential land uses and is shown in Table 6-8.

Table 6-8: Relative Increase Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Total Traffic Noise Level Increase, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with potential to generate additional traffic on existing road	Existing traffic $L_{Aeq\ (15\ hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq\ (9\ hour)}$ + 12 dB (external)

The assessment criteria provided in Table 6-7 and the relative increase criteria provided in Table 6-8 should both be considered when designing project specific noise levels, and the lower of the two should be adopted. For example, if the assessment criteria is 60 dB(A) and the relative increase criteria is 42 dB(A), then a project specific noise level of 42 dB(A) should be adopted. Similarly, if the assessment criteria is 60 dB(A) and the relative increase criteria is 65 dB(A), a project specific noise level of 60 dB(A) should be adopted.

6.3.5 Exceedance of Criteria

If the criteria shown in both Table 6-7 and Table 6-8 cannot be achieved, justification should be provided that all feasible and reasonable mitigation measures have been applied.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

6.3.6 Assessment Locations for Existing Land Uses

Table 6-9: 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.)
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.

6.4 CONSTRUCTION NOISE AND VIBRATION CRITERIA

Criteria for construction noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from The Assessing Vibration – A Technical Guideline (DEC, 2006) as relevant to human comfort, as well as British Standard BS7385-Part 2: 1993 'Evaluation and measurement for vibration in buildings' and German standard DIN4150-Part 3:1999 'Structural Vibration Part 3 – effects of vibration on structures'.

6.4.1 NSW Interim Construction Noise Guideline

Note: The criteria adopted in this assessment are consistent with the Draft Construction Noise guideline 2020.

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 6-10 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 6-10: 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 6-11 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 6-11: 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 6-12.

Table 6-12: Construction Noise Criterion dB(A)

Receiver	Land Use	Period	RBL L_{A90}	Management Level $L_{Aeq(15\ minute)}$
R1-R3	Residential	Standard Hours	42	52
R4-R6	Residential	Standard Hours	44	54
R7-R11	Residential	Standard Hours	42	52
R12-15	Industrial	Standard Hours	-	75

6.4.2 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. In addition the Guideline to Desining, Constructing and Operating around Existing AS2885 Natural Gas Pipelines is referenced.

6.4.3 Guideline To Designing, Constructing and Operating around Existing AS2885 Natural Gas Pipelines

Vibrations from any equipment or processes including vibrating compaction equipment, jack hammers, rock hammers, seismic measuring processes, etc. are not to exceed peak particle velocity readings of 20 mm/second at the nearest surface of the buried pipeline.

In the event that such vibrating equipment is to be used close to the pipeline or in blasting operations, suitable trials are to be conducted prior to proceeding with the proposed development to ensure that the stipulated peak particle velocities will not be exceeded. Suitable vibration monitoring equipment is to be used to record the tests and works as they progress in accordance with agreed procedures with Jemena.

6.4.4 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 6-13: 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

6.4.5 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 6-14: 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

6.4.6 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 6-15: 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

There is no vibration generated that is observable around the site. The vibration criteria is not applicable.

7. OPERATIONAL NOISE IMPACT ASSESSMENT

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

7.1 MODELLING METHODOLOGY

Noise propagation modelling was carried out using the Concawe algorithm within SoundPLAN. This model has been extensively utilised by Benbow Environmental for assessing noise emissions for existing and modified projects, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site at the specified receiver, by calculating the contribution of each noise source. Other model inputs included the noise sources, topographical features of the subject area, surrounding buildings, noise walls and receiver locations.

The modelling scenario has been carried out using the L_{Aeq}, 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).

7.2 NOISE SOURCES

Existing noise sources have been based off onsite measurements undertaken as part of previous noise assessments for the site, (report reference 161188-03_NIA_Rev5), where the majority of ground level sources were measured and (report reference 171190_Noise_Rev2), where the sound power level of the top of the stack was measured using an acoustic camera. These stack mouths represent the most dominant noise sources from the site, all existing stacks have been modelled with a sound power level of 105 dB(A) and directivity.

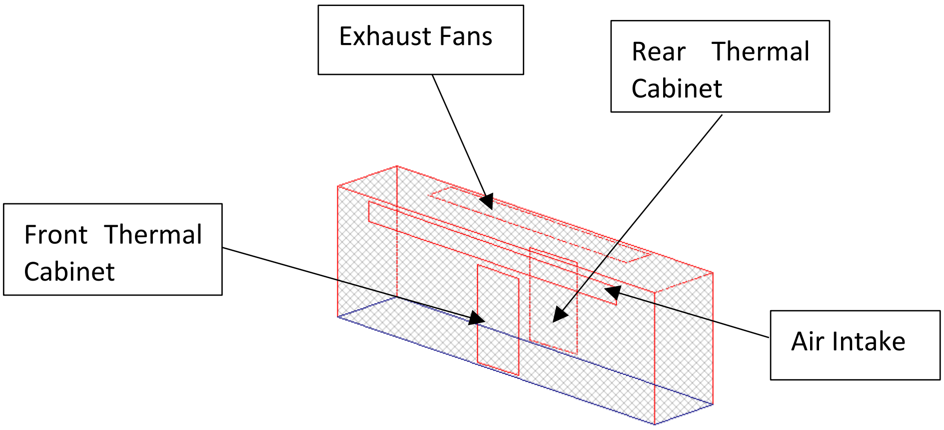
Detailed noise source locations are provided in Attachment 5.

The supplier of the BESS units with the greatest measured noise levels has measured sound pressure levels at 10m from the unit at heights of 1m and 2m to the front, rear left and right which were calibrated by BE within Soundplan as an industrial building to achieve the measured sound pressure levels for 100% load with the most reasonable worst case fan duty (100% battery fan operations, and 20% power electronics (PE) fan operations).

7.2.1 Modelled Sources

To represent the worst-case cumulative scenario, we have specifically modelled the 36 x BESS units at 100 % load with the most reasonable worst case fan duty (100% battery fan operations, and 20% PE fan operations) with the power plant. No other developments were incorporated. The location of the BESS units are next to a proposed northern boundary's fence, to allow for shielding and lessen the impacts at R13. This arrangement can be seen in Figure 7-3. It is noted that the modelled layout is indicative with the specific layout to be determined.

Figure 7-1: BESS Unit



Illustrative images are presented below showing the existing and proposed development.

Figure 7-2: Scenario 1: Existing Noise Source Configuration

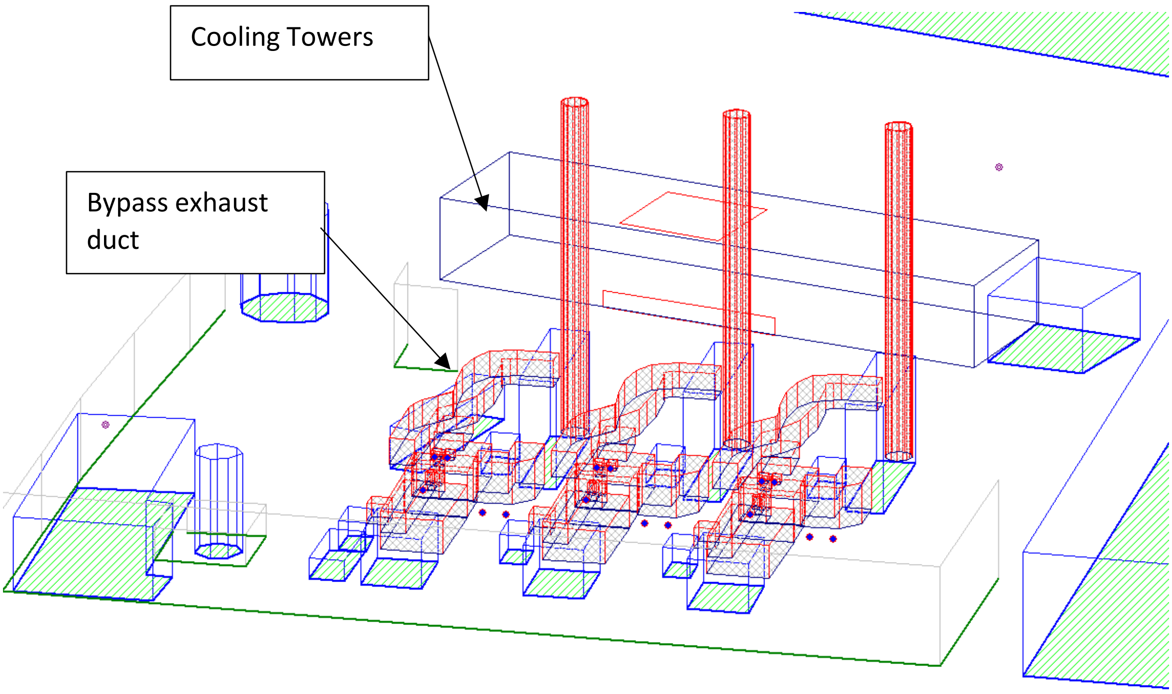
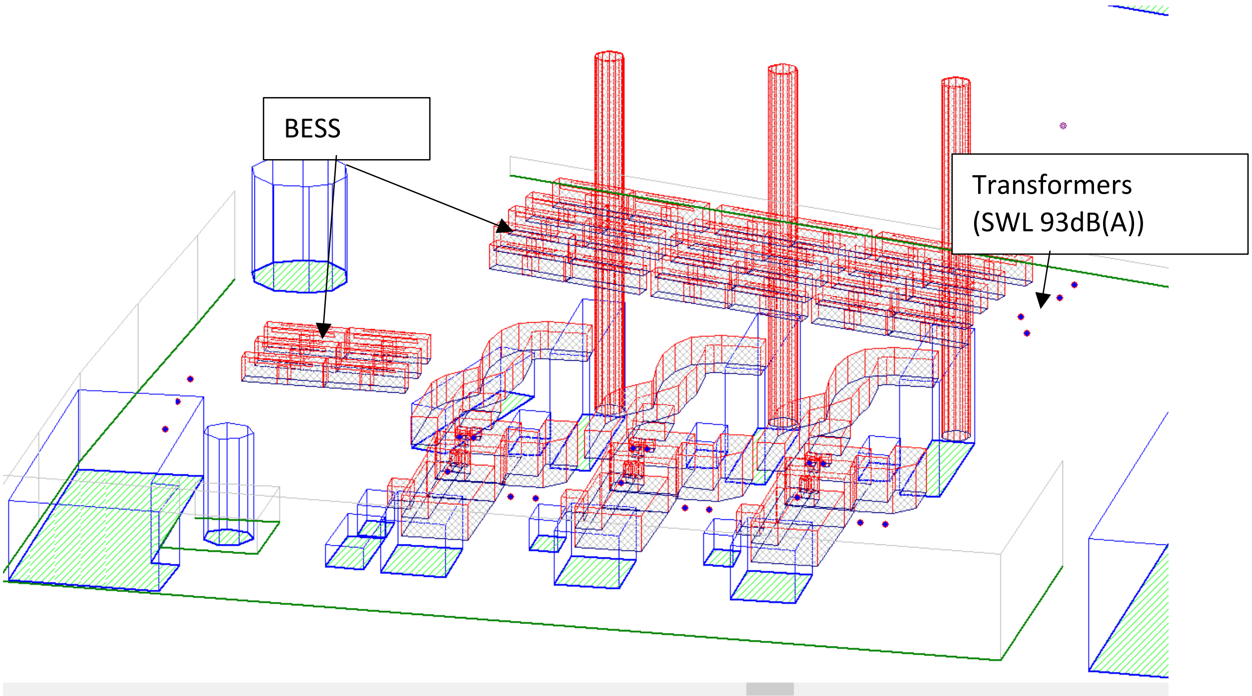


Figure 7-3: Scenario 2: Proposed Noise Source Configuration



Proposed noise sources are provided in the table below.

Table 7-1: Proposed Noise Sources 1/3 Octave dB(A)

Noise Source	Quantity	Overall L_{AEQ}	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
Cooling Tower	3	100	51	57	63	69	72	76	78	81	85	90
			91	91	91	90	89	87	86	86	85	85
			84	83	83	82	80	79	78	75	72	70
18MVA transformer	9	93	19	29	39	57	64	71	90	86	81	73
			73	74	75	74	73	72	71	70	69	68
			67	68	65	62	55	55	55	46	46	46
BESS Unit Front Façade	36	69/m^2 (24.5m^2)	-	-	-	-	-	-	46	44	48	46
			47	49	64	55	57	61	56	61	56	57
			57	51	50	49	46	41	33	26	19	15
BESS Unit Right Façade (100% load)	36	69/m^2 (4.5m^2)	-	-	-	-	-	-	46	44	48	46
			47	49	64	55	57	61	56	61	56	57
			57	51	50	49	46	41	33	26	19	15
BESS Unit Left Façade	36	69/m^2 (4.5m^2)	-	-	-	-	-	-	46	44	48	46
			47	49	64	55	57	61	56	61	56	57
			57	51	50	49	46	41	33	26	19	15
BESS Unit Rear Façade	36	71/m^2 (24.5m^2)	-	-	-	-	-	-	48	46	50	48
			49	51	66	57	59	63	58	63	58	59
			59	53	52	51	48	43	35	28	21	17
BESS Unit	36	87/m^2	-	-	-	-	-	-	50	49	56	54

Noise Source	Quantity	Overall L_{AEQ}	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
Thermal Cabinet Rear		(2.5 m²)	57	57	74	69	72	79	71	79	75	79
			77	74	76	75	73	68	63	57	50	42
BESS Unit Thermal Cabinet Front	36	90/m² (2.5 m²)	-	-	-	-	-	-	53	52	59	57
			60	60	77	72	75	82	74	82	78	82
			80	77	79	78	76	71	66	60	53	45
BESS Unit Air Intake	36	85/m2 (2.8 m²)	-	-	-	-	-	-	48	47	54	52
			55	55	72	67	70	77	69	77	73	77
			75	72	74	73	71	66	61	55	48	40
BESS Unit Exhaust fans	36	90/m² (3.6 m²)	-	-	-	-	-	-	57	56	59	62
			67	72	83	72	77	79	79	82	80	79
			80	77	75	77	71	67	61	54	46	39

7.2.2 Modelling Scenarios

Table 7-2 presents the modelled scenarios for this noise assessment. Scenario 1 considers the existing noise levels generated from the site. Scenario 2 considers the cumulative noise impacts from the existing facility and the proposed 36 BESS Units. Noise enhancing wind conditions are those which are wind-affected (see section 5.2.1 for details).

Table 7-2: Modelled Noise Scenarios

Scenario	Description
Scenario 1A:	Existing operations under neutral weather conditions
Scenario 1B:	Existing operations under noise enhancing wind conditions
Scenario 2A:	Proposed operations under neutral weather conditions
Scenario 2B:	Proposed operations under noise enhancing wind conditions

7.2.3 Modelling Assumptions

The relevant assessment period for operational noise emissions is 15 minutes when assessing noise levels against the project noise trigger levels. 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:

- All scenarios model all considered existing generators are operating 100% of the time as a worst case scenario.
- Off-site topographical information was obtained from the Department of Lands, Six Maps, with contour maps having intervals of 10 m.
- Heights of the on-site warehouse and surrounding buildings have been taken from the site visits and from survey plans provided by the client.

- Off-site structures such as warehouses, buildings and walls surrounding the project site have been included in the model.

- The existing gas turbine enclosure buildings have been modelled as industrial buildings with external area sources. These were measured in a previous noise assessment Ref: 161188-03_NIA_Rev5.

- 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 36 x BESS units at 100 % load the most reasonable worst case fan duty (100% battery fan operations, and 20% PE fan operations) with the power plant.

- All sources will be operational for 100% of the operational hours of the site.

- The noise from the top of the stacks includes directivity in accordance with Environmental Noise Control Manual Data Sheet 207–1 1994 Appendix 3.
  (Although this Manual is no longer supported by the NSW EPA, the data sheets are still relevant and this one in particular has been used in many plants and has been found from field calibration to be accurate.)

7.3 PREDICTED NOISE LEVELS

Noise levels at the nearest receivers have been calculated and results of the predictive noise modelling considering existing and proposed operational activities are shown in Table 7-3.

Table 7-3: Predicted Noise Levels

Receptor	Receiver Type	Project Criteria				Predicted Scenarios $L_{Aeq, 15 minute}$			
		$L_{Aeq(15 minute)}$			L_{AMAX}	1A - Existing	1B – Existing (Wind)	2A - Proposed	2B – Proposed (Wind)
		Day	Evening	Night	Night				
R1	Residential	47	47	43	56	41✓	-	41✓	-
R2	Residential	47	47	46	56	41✓	-	42✓	-
R3	Residential	47	47	43	56	40✓	-	41✓	-
R4	Residential	49	49	48	59	42✓	-	43✓	-
R5	Residential	49	48	43	59	40✓	-	40✓	-
R6	Residential	49	48	43	59	38✓	-	38✓	-
R7	Residential	47	46	41	52	29✓	-	29✓	-
R8*	Residential	47	46	41	52	32✓	34✓	34✓	37✓
R9*	Residential	47	46	41	52	25✓	27✓	26✓	29✓
R10*	Residential	47	46	41	52	27✓	31✓	29✓	33✓
R11*	Residential	47	46	41	52	24✓	28✓	27✓	32✓
R12*	Industrial	68	68	68	-	54✓	56✓	59✓	61✓
R13*	Industrial	68	68	68	-	54✓	58✓	67✓	69×
R14	Industrial	68	68	68	-	53✓	-	55✓	-
R15	Industrial	68	68	68	-	53✓	-	53✓	-

✓Complies × Non-compliance

*Wind conditions applicable

Note: as per Table 5-1, only R8-R13 are wind-affected receivers.

Figure 7-4: Existing Noise Impacts

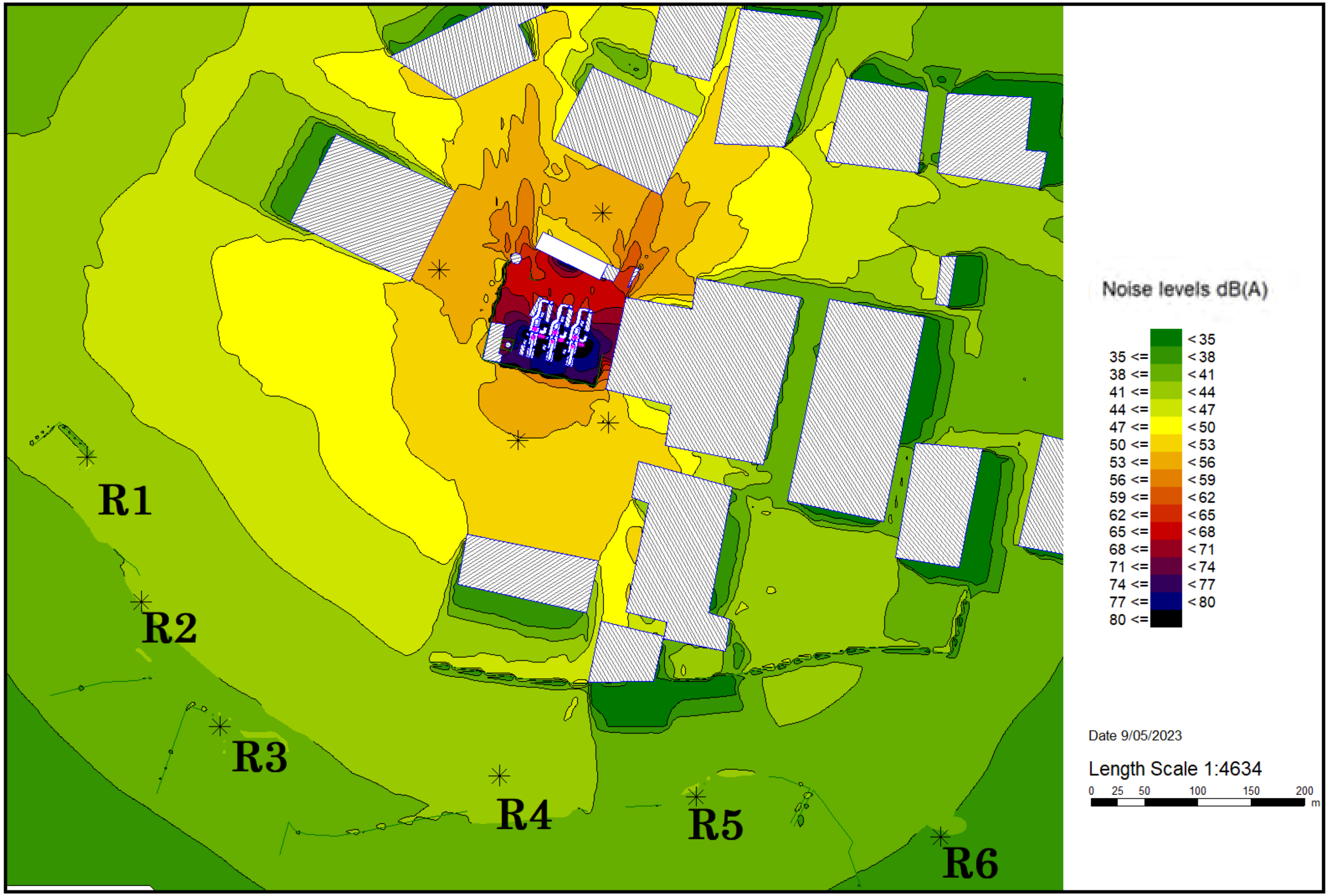


Figure 7-5: Proposed Noise Impacts – Scenario 2A

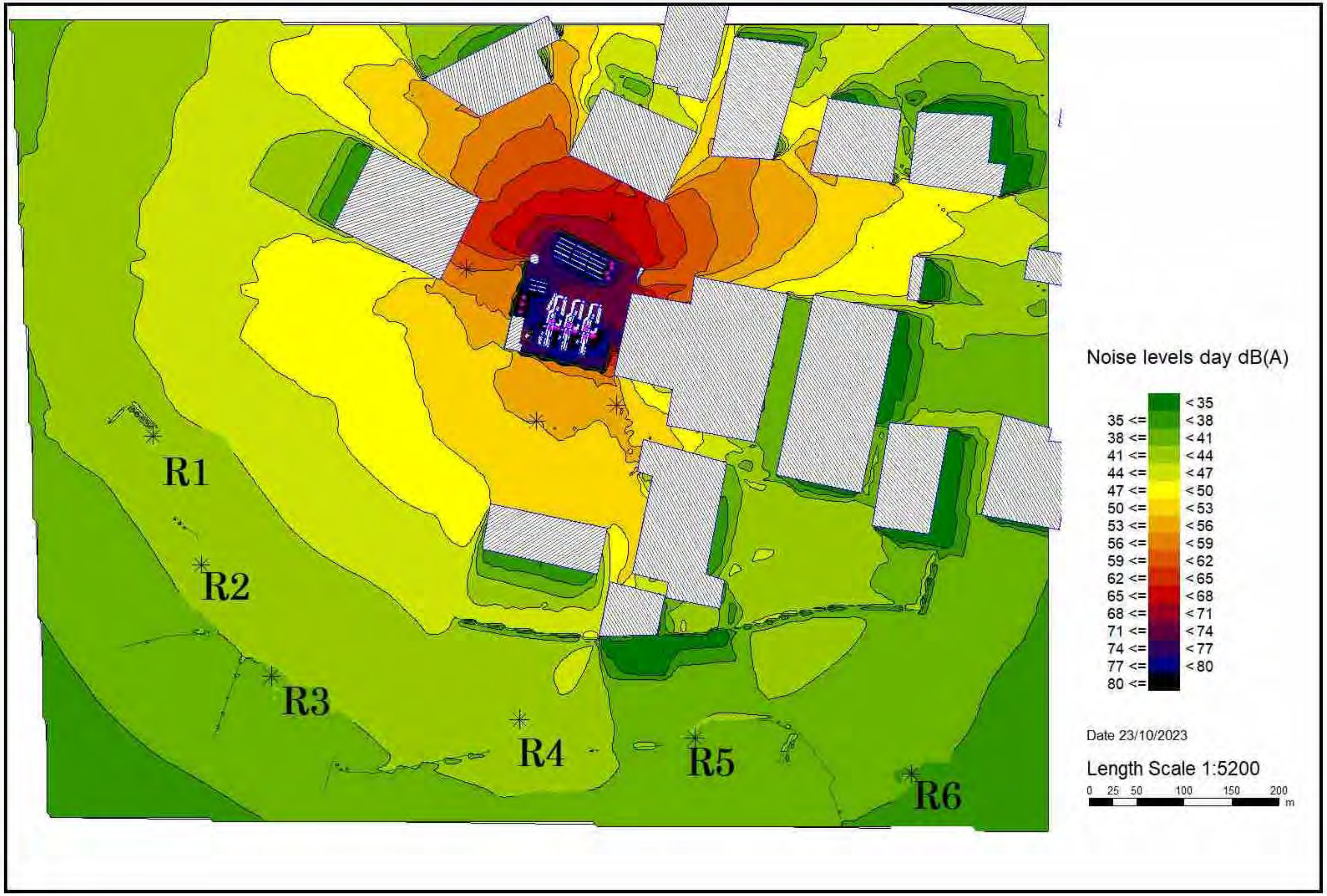
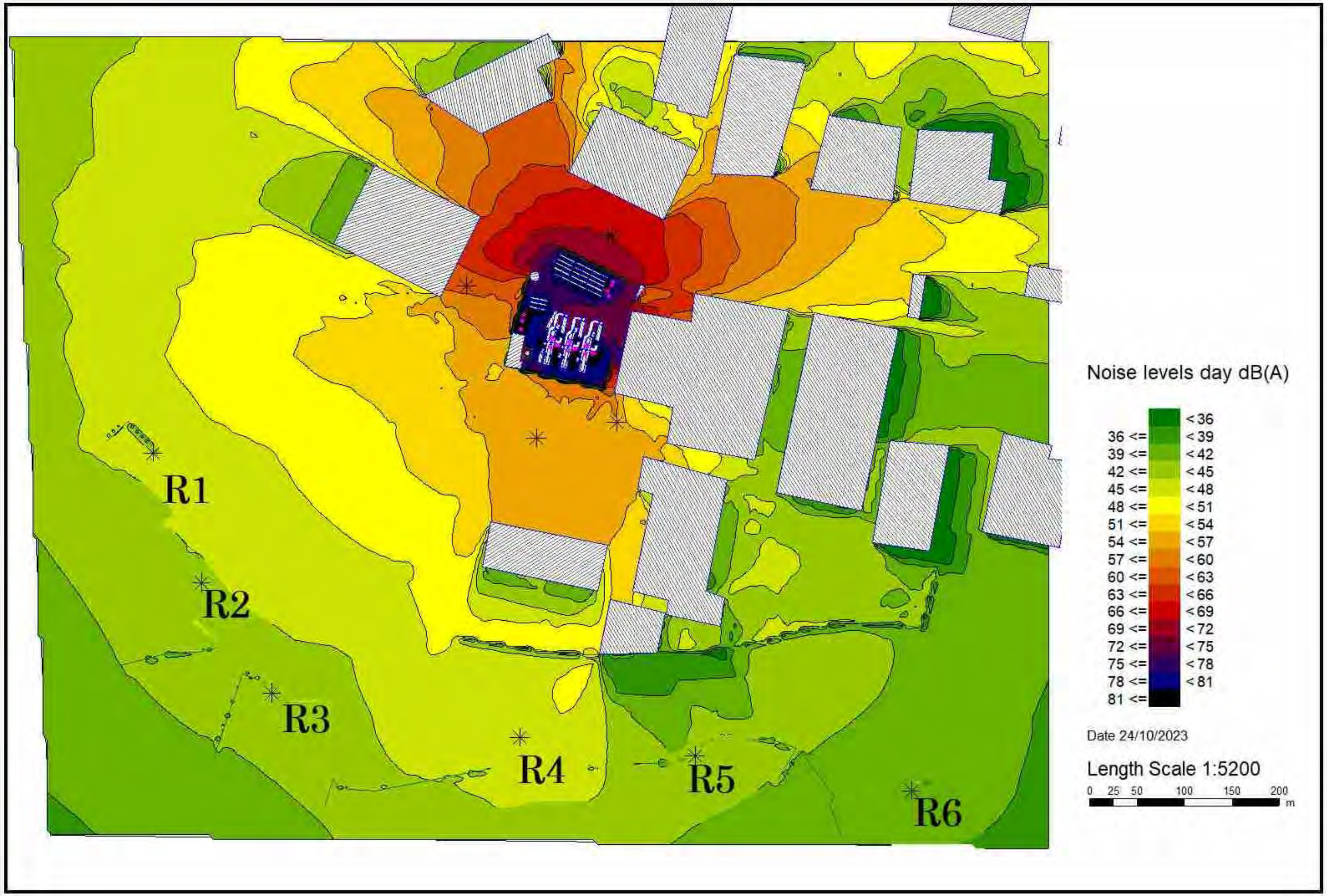
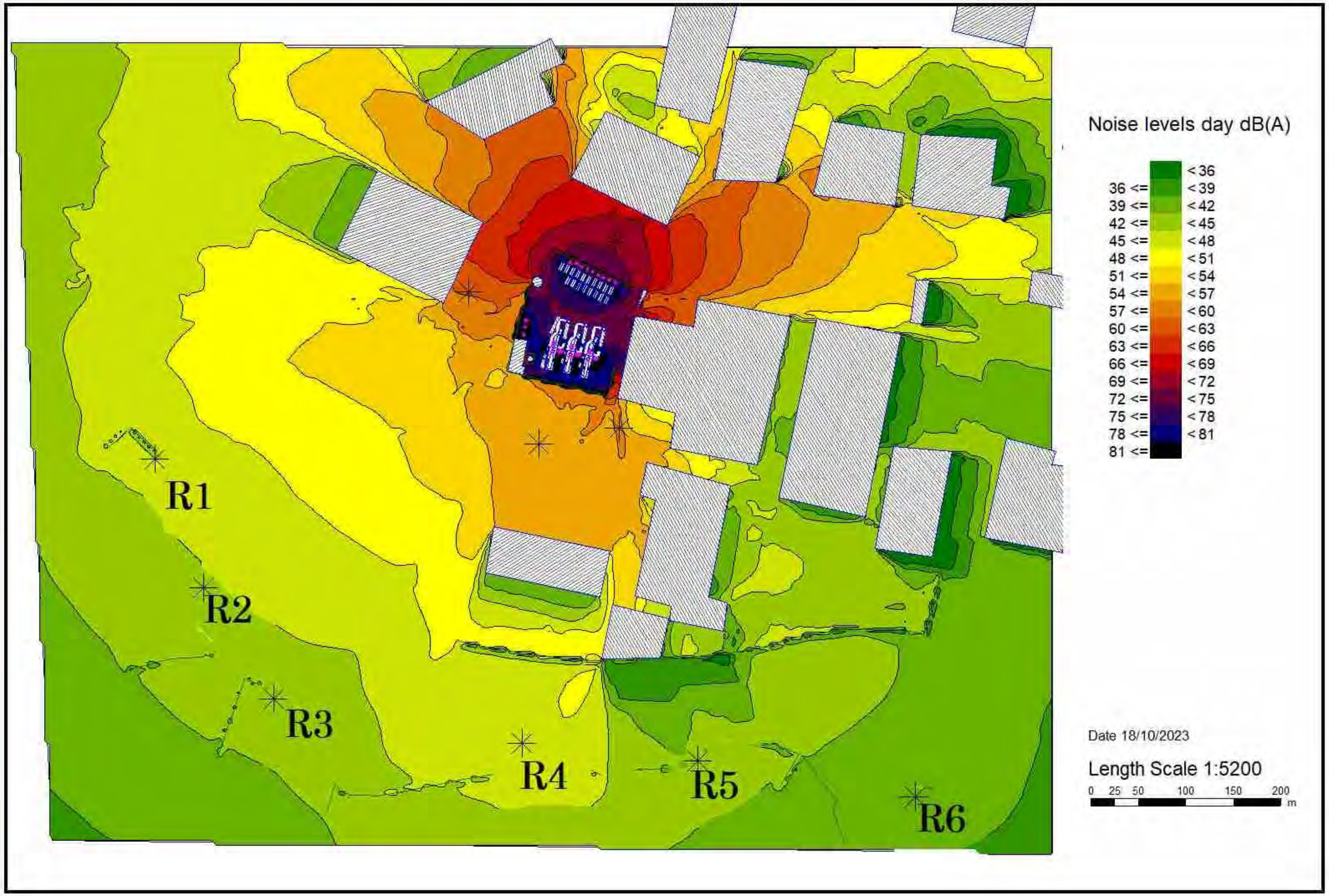


Figure 7-6: Proposed Noise Impacts – Scenario 2B




Noise levels day dB(A)
< 36
36 <= < 39
39 <= < 42
42 <= < 45
45 <= < 48
48 <= < 51
51 <= < 54
54 <= < 57
57 <= < 60
60 <= < 63
63 <= < 66
66 <= < 69
69 <= < 72
72 <= < 75
75 <= < 78
78 <= < 81
81 <=
R1
R2
R3
R4
R5
R6
Date 18/10/2023
Length Scale 1:5200
0 25 50 100 150 200 m

7.3.1 Low Frequency

Low frequency noise for the three scenarios described in this section, has been evaluated as part of this assessment. This is described in Section 6.2.6. R1-R6 has been assessed as they are the worst receivers for low frequency noise. The predicted noise levels have been calculated using the frequency spectrum measured by the acoustic camera at Position A (Ref: 171190_Noise_Rev2) and the noise model.

Table 7-4: Predicted Low Frequency Contribution dB-Linear

Receiver	Scenario	Freq.	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
R1	1A: Existing	Predicted levels	56	46	54	53	45	50	46	37	42
		Exceedance	0	0	0	3	0	2	0	0	0
	2A: Proposed	Predicted levels	56	47	54	54	46	50	48	38	42
		Exceedance	0	0	0	4	0	2	0	0	0
R2	1A: Existing	Predicted levels	56	46	55	54	45	51	47	37	43
		Exceedance	0	0	1	4	0	3	0	0	0
	2A: Proposed	Predicted levels	57	46	55	54	45	50	49	38	42
		Exceedance	0	0	1	4	0	2	1	0	0
R3	1A: Existing	Predicted levels	56	46	55	54	45	51	47	37	43
		Exceedance	0	0	1	4	0	3	0	0	0
	2A: Proposed	Predicted levels	56	46	54	53	45	50	47	37	41
		Exceedance	0	0	0	3	0	2	0	0	0
R4	1A: Existing	Predicted levels	57	46	55	54	45	50	49	37	42
		Exceedance	0	0	1	4	0	2	1	0	0
	2A: Proposed	Predicted levels	57	46	55	54	45	50	50	37	43
		Exceedance	0	0	1	4	0	2	2	0	0
R5	1A: Existing	Predicted levels	56	46	54	53	45	49	46	37	40
		Exceedance	0	0	0	3	0	1	0	0	0
	2A: Proposed	Predicted levels	57	46	55	53	45	49	47	37	41
		Exceedance	0	0	1	3	0	1	0	0	0
R6	1A: Existing	Predicted levels	55	45	53	52	44	48	46	36	39
		Exceedance	0	0	0	2	0	0	0	0	0
	2A: Proposed	Predicted levels	54	44	52	50	43	47	45	35	39
		Exceedance	0	0	0	0	0	0	0	0	0

As can be seen in the table above, the existing development exceeds the threshold levels by up to 4 dB. This is from low frequency noise generated from the existing peaking plant, primarily from the exhaust stack mouths. The proposed development generally increases the predicted low frequency noise octave bands by 1 dB resulting in exceedances of the threshold levels by up to 4 dB. If a 2dB penalty based on the Noise Policy for Industry 2017 were to be applied, the existing and proposed development would comply with the Project Noise Trigger.

Note an analysis of the total dB(C) – dB(A) weighted predicted noise levels for R8 was 11, as this is less than 15 low frequency is not a feature at this receptor and therefore a penalty does not apply.

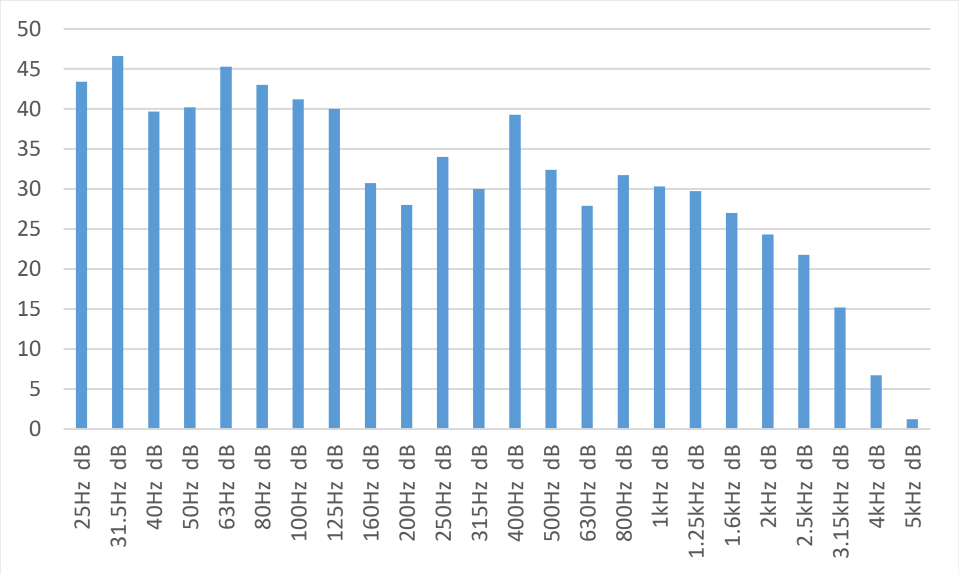
7.3.2 Sleep Disturbance

The plant equipment will operate relatively continuously and does not generate any impulse noise. Therefore, the L_{Amax} from the site is expected to be only 2-3 dB(A) above the predicted $L_{Aeq\ 15\ minute}$ values shown in Table 7-3 and are expected to easily comply with the sleep disturbance criteria (L_{Amax} 52-59dB(A)). No further assessment of sleep disturbance is considered warranted.

7.3.3 Tonal Noise

One-third octave levels at residential receptors were assessed for tonal impacts, in particular tonal impact at 400Hz was carefully assessed as this is an elevated tone for the BESS sources shown in Table 7-1. However no tonal component in accordance with the Noise Policy for Industry 2017 was calculated. The worst affected receptor was R8 regarding tonal component however does not trigger a penalty in accordance with the Noise Policy for Industry as the difference between one neighbouring band is less than 8dB.

Figure 7-7: R8 Predicted 1/3 Octave Results



7.3.4 Discussion of Predicted Noise Levels

The existing and proposed development was assessed against the low frequency noise requirements of the Noise Policy for Industry (2017) and found that due to the existing peaking plant, a 2 dB(A) penalty applies at select receptors. With the addition of the low frequency noise penalty the existing development would comply with the Project Noise Trigger Levels at all receptors during all time periods and applicable weather conditions. Additionally, with the proposed addition of the BESS facility the cumulative noise is predicted to comply with the Project Noise Trigger Levels at all residential receptors during all time periods with the addition of a 2 dB(A) penalty.

A residual noise impact above the project noise trigger levels is predicted at the neighbouring industrial facility to the north of the site (Lot 1000 DP1077000) as shown in Figure 7-5 and Figure 7-6. The region that exceeds the criteria (68 dB(A)) is the hardstand area currently being used as a truck depot/material storage area to the north and is not predicted to exceed the criteria at the existing neighbouring industrial buildings.

The noise levels from the thermal system consists of two components with 4 out of 9 fans cooling the power electronics (PE Fans) and 5 out of 9 fans cooling the battery modules. The predicted noise levels are based on a reasonable worst case fan duty (100% battery fan operations, and 20% PE fan operations), where all 36 units are operating at 100% load. In practice this would only occur for approximately 5% of the time on the hottest days of the year. In practice most of the time (>95% of the time over the year) the PE fans operate at 20% duty or less and the battery fans operate at 40% duty or less, under these typical conditions the noise levels from each BESS unit will be more than 10 dB(A) less than those modelled as worst-case and would easily achieve compliance at the neighbouring industrial site.

Constructing a noise wall to reduce noise impacts from the exhaust fans at the top of the BESS units at the neighbouring industrial premises is not considered a reasonable/feasible measure as this would require a wall greater than 3.5 m high which would increase noise levels at residences to the south due to reflections.

A proposed northern boundary's fence of 2.1 m has been modelled across the length of the northern boundary. This is made from Colorbond steel.

7.4 Mitigation Measures

The design of the BESS should be undertaken in general accordance with the assumptions outlined in Section 7.1. An operational Noise Management Plan (NMP) or equivalent should be developed to minimise the risk of adverse noise impacts during the operation of the facility. The operational NMP should have consideration to:

- The relevant conditions (to be confirmed);
- The Noise Policy for Industry (EPA, 2017);
- Approved methods for the measurement and analysis of environmental noise in NSW (EPA, 2021); and
- A process for managing complaints.

This plan is to be refined and developed during detailed design. The below mitigation and management measures provide recommendations for inclusion into this plan during the operation of the Project.

Complaints handling

A complaints procedure is to be developed and captured to manage situations where nearby receivers perceive noise to be a problem. The procedure should contain the following as a minimum:

- Responsibility for investigation into the complaint (i.e. site manager);
- Exploration of at-source mitigation if problem noise source identified;
- If required, noise monitoring at the complainant's property should be undertaken if a noise source if the complainant is not satisfied with the corrective action;
- Recording mechanism of all complaints and corrective actions; and
- Notification of potentially affected receivers if observations indicate that the noise criteria is being exceeded due to site activities. The affected receiver should be notified of exceedances and the source of the impact in writing within 48 hours of detection and verification.

8. ROAD TRAFFIC NOISE ASSESSMENT

The proposed development is expected to generate less than 10 staff car movements per day. Regular truck movements are not expected as part of the site's activities. The vehicles have direct access to Cumberland Hwy via Herbert Place without passing residential receivers. The expected traffic generated from the facility is not expected to have any road noise impacts on the surrounding sensitive receivers. A detailed Road Traffic Noise Assessment is not considered warranted, as the proposal would easily achieve compliance with the RNP.

9. CONSTRUCTION IMPACT ASSESSMENT

9.1 MODELLED NOISE GENERATING SCENARIOS

Three construction scenarios that have the potential to generate noise at surrounding receivers are modelled. The scenarios are listed in Table 9-1, and are modelled for:

- Surface Works (Scenario 1);
- Concreting works (scenario 2); and
- Building works for the installation of the BESS facility (scenario 3);

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 9-1.

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 Scenarios for Proposed Construction Works

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

9.2 MODELLING METHODOLOGY

9.2.1 Noise Model

Noise propagation modelling for the construction activities was carried out using the ISO 9613 algorithm within SoundPLAN v7.3. 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;

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

9.2.2 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
Concrete Saw	**113**	87	86	91	95	100	105	111	104
Excavator 20T	**110**	103	101	100	101	102	102	97	90
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

9.3 Construction Predicted Noise Levels

Results of the predictive noise modelling of the construction activities are shown in Table 9-3. It can be seen that the predicted noise levels comply with the construction noise criteria at all receivers during standard construction hours for all scenarios.

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

Receiver	Noise Management Levels ($L_{eq,15\ minute}$ dB(A)) Standard Hours	Scenario (Standard Hours) (L_{eq}, dB(A))		
		1	2	3
R1	52	35✓	22✓	24✓
R2	52	36✓	29✓	28✓
R3	52	33✓	26✓	25✓
R4	54	37✓	30✓	29✓
R5	54	32✓	22✓	21✓
R6	54	27✓	18✓	15✓
R7	52	24✓	13✓	13✓
R8	52	33✓	27✓	25✓
R9	52	20✓	9✓	8✓
R10	52	26✓	22✓	21✓
R11	52	26✓	21✓	21✓
R12	75	64✓	55✓	53✓
R13	75	67✓	65✓	62✓
R14	75	57✓	55✓	48✓
R15	75	51✓	41✓	43✓

✓Complies ✗ Non-compliance

It can be seen that the predicted noise levels associated with construction comply at all receptors during all scenarios. None of the predicted noise levels exceed the highly noise affected management level of 75 dB(A).

9.3.1 Construction Noise Mitigation Measures

The NSW Department of Environment and Climate Change's Interim Construction Noise Guideline 2009 provides guidance on standard mitigation measures that may be applied as standard practice on projects where exceedances of the noise management levels are predicted. The following controls should be implemented with consideration of the following mitigation measures where feasible and reasonable:

Consultation

- Works notifications to impacted receivers prior to works commencing;
- Maintain community relations throughout construction period; and
- Complaints handing through appropriate channels (i.e. 24-hour toll-free complaints line) and response mechanism.

On site management

- Construction hours of operation are to be followed (standard hours of work Monday to Friday 7am to 6pm, Saturday 8am to 1pm with no work on Sundays or public holidays);
- 'Toolbox talks' should be held at regular intervals so that all workers on the site are aware of current noise issues and the mitigation measures being implemented on site at the time;
- A Construction Environmental Management Plan (CEMP) to be regularly updated to account for any refinements/changes to noise management issues and strategies through detailed design;
- Out of hours works procedure to be developed as part of the CEMP; and
- Conduct noise and vibration monitoring at the commencement of works or as required to validate predicted noise and vibration levels.

Source mitigation measures

- All plant and equipment should have operating sound power levels equal to or lower than those assessed in this report; and
- All plant and equipment is to be maintained through regular inspections to ensure it is in good working order to ensure sound power levels are within the defined limits.

10. VIBRATION IMPACT ASSESSMENT

In the NSW TfNSW Construction Noise Strategy document and Assessing Vibration – a Technical Guideline, construction 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. It is understood that equipment likely to cause significant vibration is not proposed as part of the works and would generally be limited to small excavators, jackhammers and whacker packers (handheld compactor) as required.

Furthermore, the nearest off-site building is located over 30 m from any part of the proposed works. Given this distance, there is no prospect of either cosmetic damage (as per BS 7385) or human response (OH&E Vibration Guideline) given the proposed construction activities. Due to the proximity of the site to nearest receivers and limited vibration generating activities, no vibration impacts are expected from the proposed construction or operational activities. A detailed Vibration Impact Assessment is not considered warranted.

11. CONCLUDING REMARKS

Benbow Environmental has been commissioned by Iberdrola Australia to undertake a noise impact assessment (NIA) to assess the noise impacts associated with the installation and operation of a battery energy storage system (BESS) at the existing Smithfield Energy Facility (SEF).

The findings of this assessment indicate that the noise levels from the proposed development would at all residential receptors for all applicable weather conditions during all time periods.

The existing and proposed development was assessed against the low frequency noise requirements of the Noise Policy for Industry (2017) and found that due to the existing peaking plant, a 2 dB(A) penalty applies at select receptors. With the addition of the low frequency noise penalty the existing development would comply with the Project Noise Trigger Levels at all receptors during all time periods and applicable weather conditions. Additionally, with the proposed addition of the BESS facility the cumulative noise is predicted to comply with the Project Noise Trigger Levels at all residential receptors during all time periods with the addition of a 2 dB(A) penalty.

A residual noise impact above the project noise trigger levels is predicted at the neighbouring industrial facility to the north of the site (Lot 1000 DP1077000) as shown in Figure 7-5 and Figure 7-6. The region that exceeds the criteria (68 dB(A)) is the hardstand area currently being used as a truck depot/material storage area to the north and is not predicted to exceed the criteria at the existing neighbouring industrial buildings.

The noise levels from the thermal system consists of two components with 4 out of 9 fans cooling the power electronics (PE Fans) and 5 out of 9 fans cooling the battery modules. The predicted noise levels are based on a reasonable worst case fan duty (100% battery fan operations, and 20% PE fan operations), where all 36 units are operating at 100% load. In practice this would only occur for approximately 5% of the time on the hottest days of the year. In practice most of the time (>95% of the time over the year) the PE fans operate at 20% duty or less and the battery fans operate at 40% duty or less, under these typical conditions the noise levels from each BESS unit will be more than 10 dB(A) less than those modelled as worst-case and would easily achieve compliance at the neighbouring industrial site.

A review of mitigation measures with regards to effectiveness and reasonability/feasibility was undertaken in accordance with the NPfI. The review identified:

- An operational Noise Management Plan (NMP) should be developed to minimise the risk of adverse noise impacts during the operation of the facility;
- A noise complaints procedure should be developed; and
- Noise monitoring should occur if complaints are received.

These are discussed further in Section 7.4.

Construction noise mitigation measures include:

- Consultation with nearby receivers;
- On-site management; and
- Choosing appropriate plant and equipment, and maintaining regularly.

These are discussed further in Section 9.3.1.

A proposed northern boundary's fence of 2.1 m has been modelled across the length of the northern boundary. This is made from Colorbond steel.

Based on the above considerations the noise from the proposed development does not significantly impact the existing environment and the site is deemed suitable for the proposed use.

Construction noise impacts are predicted to comply with the NSW Interim Construction Noise Criteria at all receivers. Vibration impacts are expected to be negligible. A detailed vibration assessment is not considered warranted. Road noise impacts have been assessed and readily achieve compliance with the RNP.

Based on the above considerations the noise from the proposed development does to not significantly impact the existing environment and the site is deemed suitable for the proposed use.

This concludes the report.

Emma Hansma	Bethany Carlyon	R T Benbow
Senior Engineer	Graduate Environmental Scientist	Principal Consultant

12. 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 Iberdrola Australia, as per our agreement for providing environmental services. Only Iberdrola Australia 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 Iberdrola Australia 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.

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 (20×10^{-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 17612 & FILT 0933

Equipment Description:	Sound & Vibration Analyser		
Manufacturer:	Svantek		
Model No:	Svan-957	**Serial No:**	15335
Microphone Type:	7052H	**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:	1018 hPa ±1.5 hPa		
Temperature:	24 °C ±2° C	**Relative Humidity:**	42% ±5%
Date of Calibration:	21/07/2015	**Issue Date:**	23/07/2015

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

CHECKED BY: ML **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.

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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: 18874

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	93.82	991.2	1.58
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05 Hz	±0.2 %

Uncertainty (at 95% c.l.) k=2

CONDITION OF TEST:
Ambient Pressure: 990 hPa ±1.5 hPa **Relative Humidity:** 42% ±5%
Temperature: 20 °C ±2° C
Date of Calibration: 26/05/2016 **Issue Date:** 26/05/2016
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004

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

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

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 20615

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: B & K
Type No: 4230 **Serial No:** 565912
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	94.12	985.6	0.40
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05 Hz	±0.2 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:
Ambient Pressure: 1012 hPa ±1.5 hPa **Relative Humidity:** 42% ±5%
Temperature: 25 °C ±2° C
Date of Calibration: 08/05/2017 **Issue Date:** 08/05/2017
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: ...... **AUTHORISED SIGNATURE:** ....
Jack Kielt

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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 C16331

Client Details Benbow Environmental
13 Daking Street
North Paramatta NSW 2151

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194438
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 22°C
Relative Humidity : 50.1%
Barometric Pressure : 99.02kPa

Calibration Technician : Dennis Kim
Calibration Date : 11/07/2016
Secondary Check: Riley Cooper
Report Issue Date : 12/07/2016

Approved Signatory : Juan Aguero

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	*±0.120dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.165dB*	*Relative Humidity*	*±4.1%*
16kHz	*±0.245dB*	*Barometric Pressure*	*±0.1kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.098dB*		

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.

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

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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

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

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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 C15637

Client Details Benbow Environmental
13 Daking Street
NORTH PARRAMATTA NSW 2151

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8780AD
Microphone Serial Number : 317856
Pre-amplifier Serial Number : 27983

Atmospheric Conditions
Ambient Temperature : 21.5°C
Relative Humidity : 49%
Barometric Pressure : 100.08kPa

Calibration Technician : Dennis Kim
Calibration Date : 07/12/2015
Secondary Check: Sandra Minto
Report Issue Date : 07/12/2015

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	*±0.120dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.165dB*	*Relative Humidity*	*±4.1%*
16kHz	*±0.245dB*	*Barometric Pressure*	*±0.1kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.098dB*		

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 1 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.

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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 C15636

Client Details Benbow Environmental
13 Daking Street
NORTH PARRAMATTA NSW 2151

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8780AE
Microphone Serial Number : 321775
Pre-amplifier Serial Number : 27982

Atmospheric Conditions
Ambient Temperature : 22.4°C
Relative Humidity : 48.1%
Barometric Pressure : 99.42kPa

Calibration Technician : Dennis Kim
Calibration Date : 15/12/2015
Secondary Check: Sandra Minto
Report Issue Date : 15/12/2015

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	*±0.120dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.165dB*	*Relative Humidity*	*±4.1%*
16kHz	*±0.245dB*	*Barometric Pressure*	*±0.1kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.098dB*		

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 1 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.

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

NATA
WORLD RECOGNISED ACCREDITATION

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.

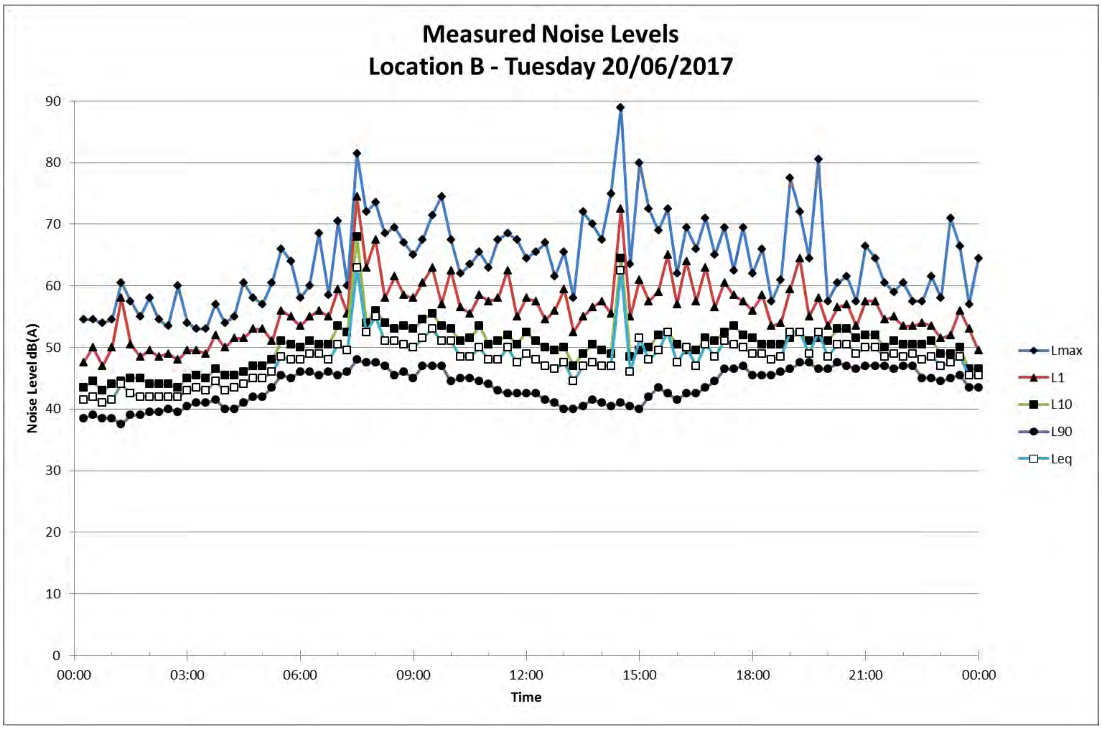
WEATHER CONDITIONS

It was 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 Loggers


Measured Noise Levels
Location B - Tuesday 20/06/2017
Noise Level dB(A)
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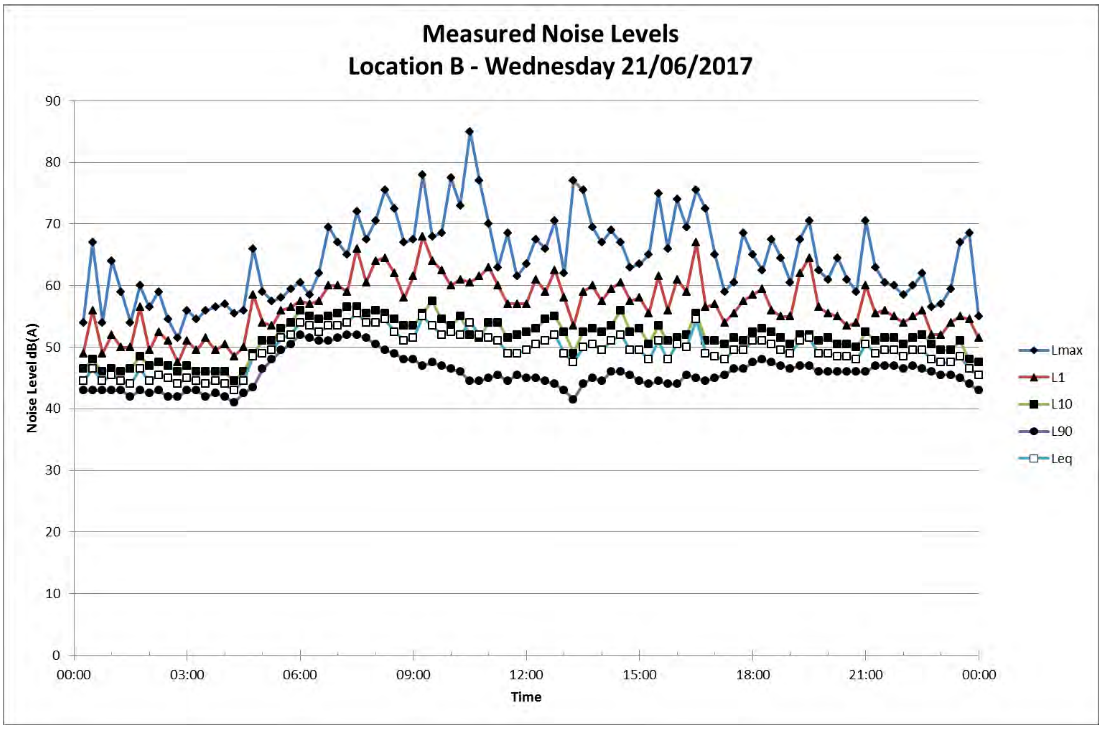
80
70
60
50
40
30
20
10
0
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Location B - Wednesday 21/06/2017
Noise Level dB(A)
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60
50
40
30
20
10
0
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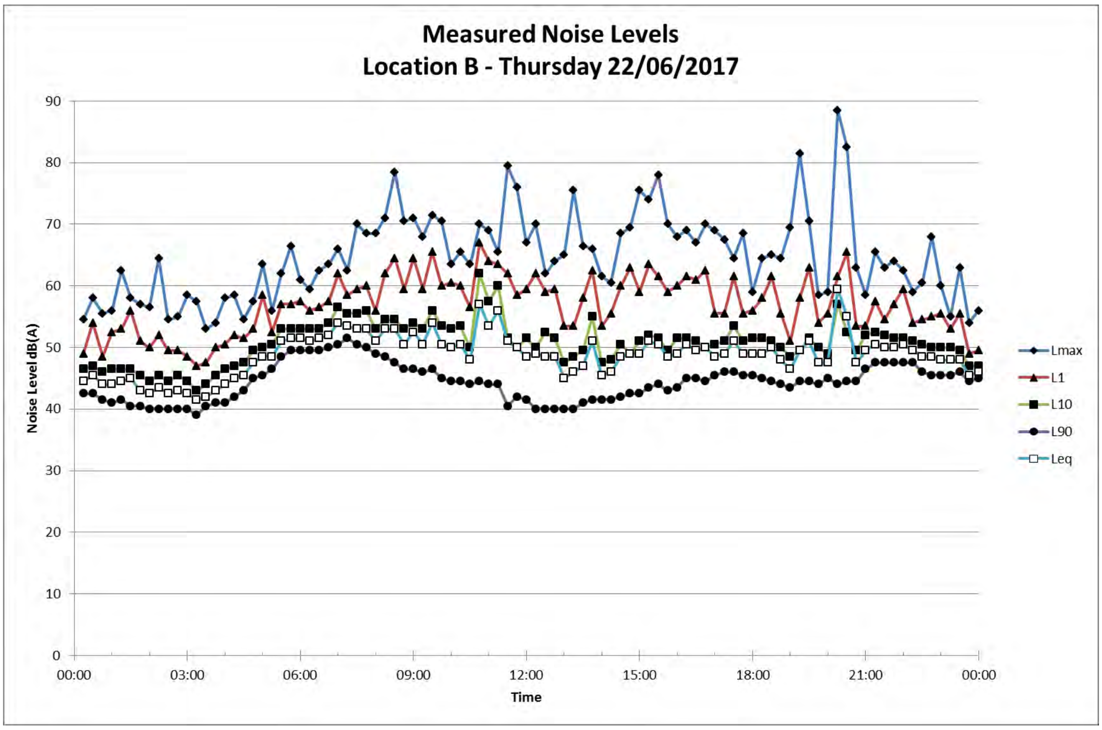
Time
Lmax
L1
L10
L90
Leq



Measured Noise Levels
Location B - Thursday 22/06/2017
Noise Level dB(A)
Time
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80
70
60
50
40
30
20
10
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00:00
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12:00
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18:00
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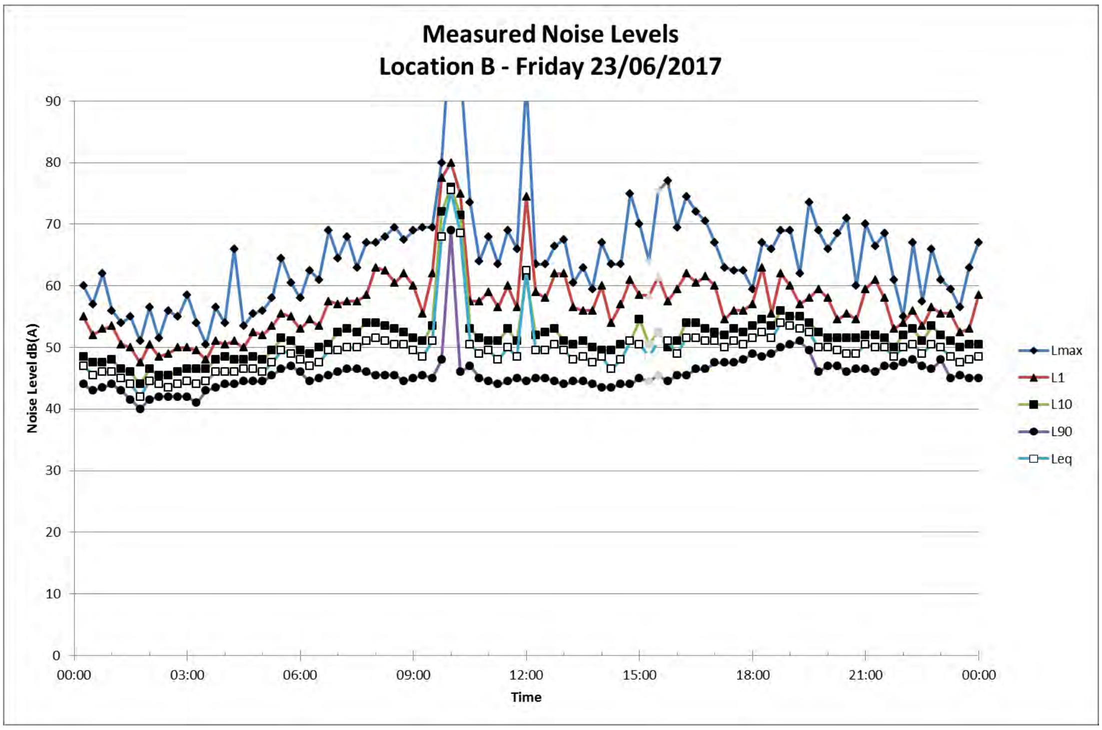
L1
L10
L90
Leq



Measured Noise Levels
Location B - Friday 23/06/2017
Noise Level dB(A)
Time
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80
70
60
50
40
30
20
10
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00:00
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12:00
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18:00
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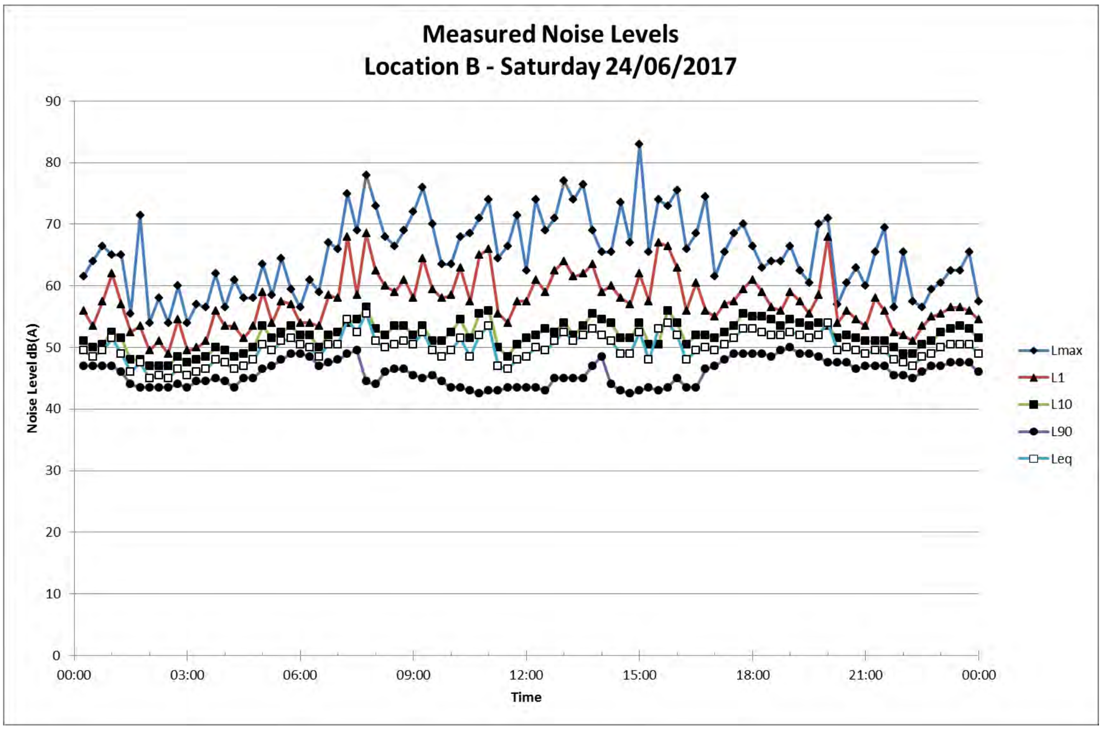
L1
L10
L90
Leq


Measured Noise Levels
Location B - Saturday 24/06/2017
Noise Level dB(A)
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60
50
40
30
20
10
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21:00
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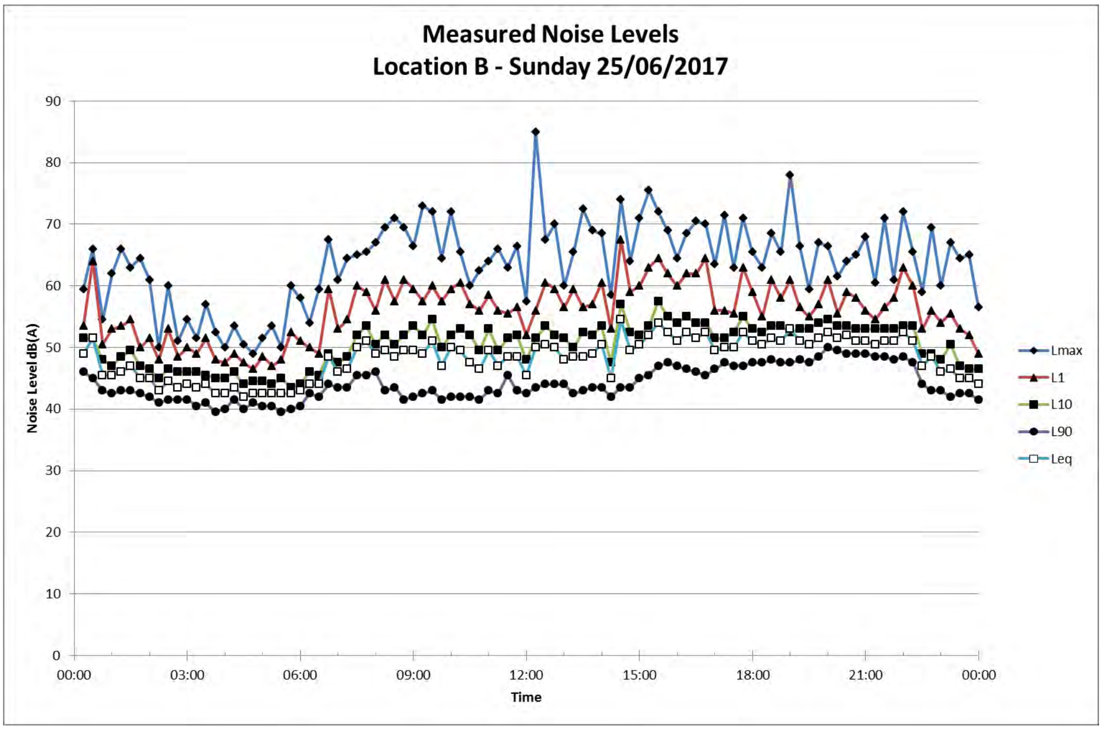
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Location B - Sunday 25/06/2017
Noise Level dB(A)
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60
50
40
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20
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Time
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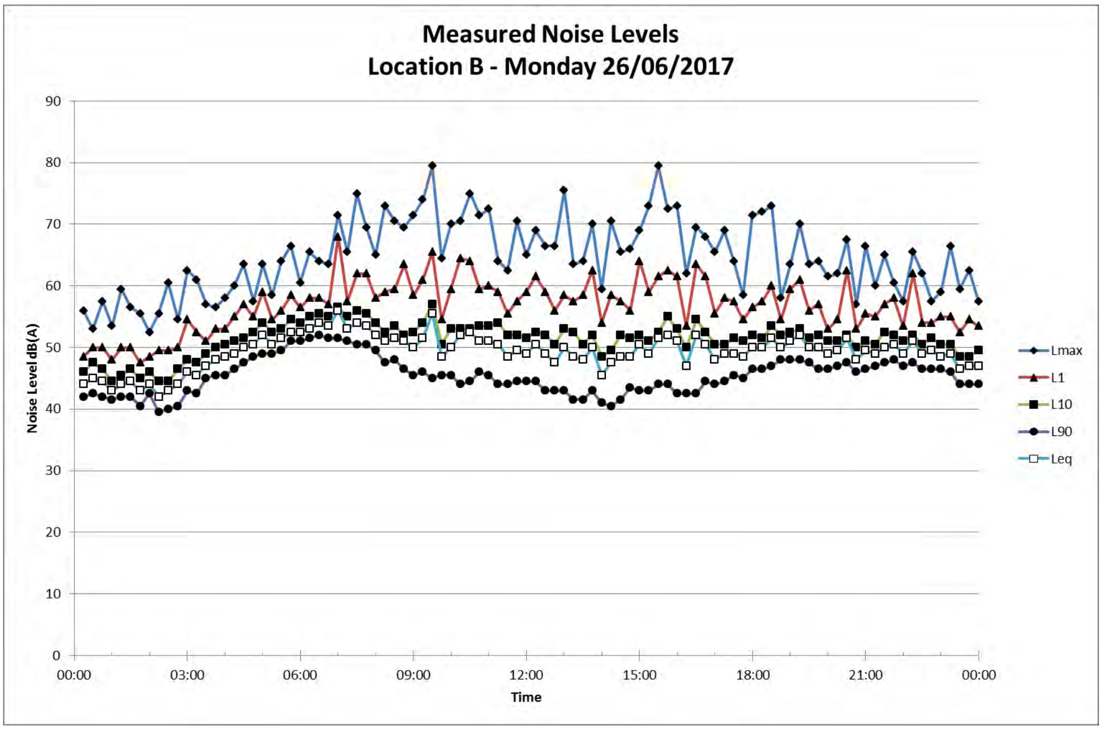
L1
L10
L90
Leq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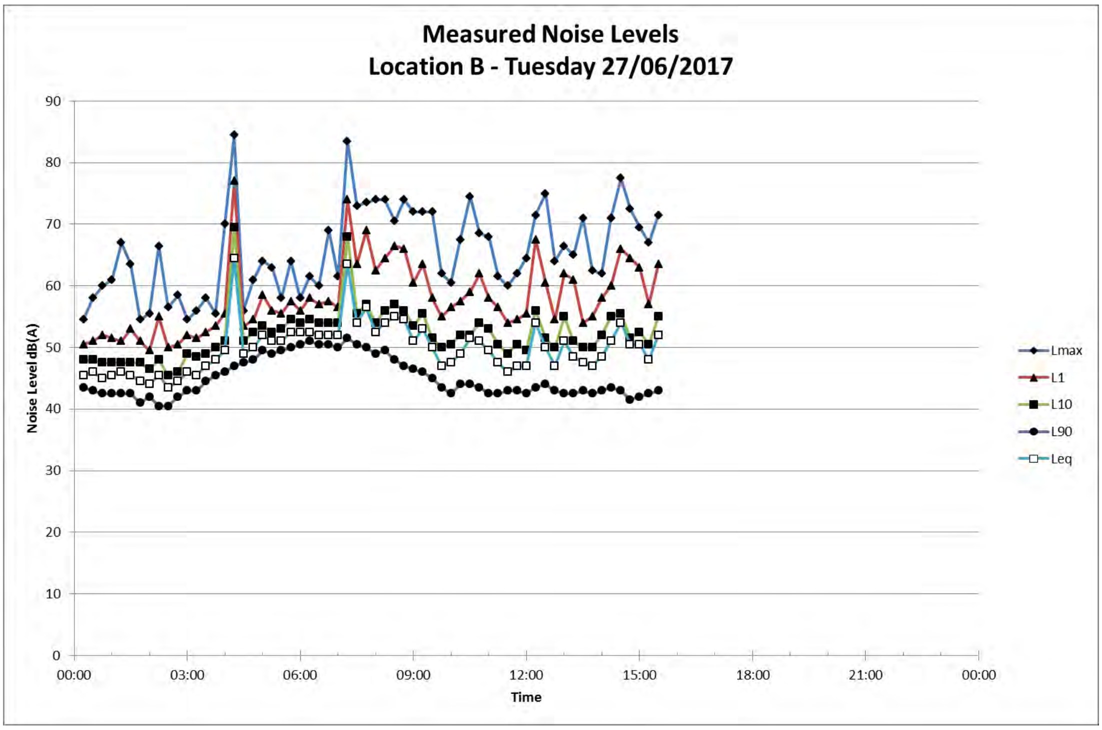
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq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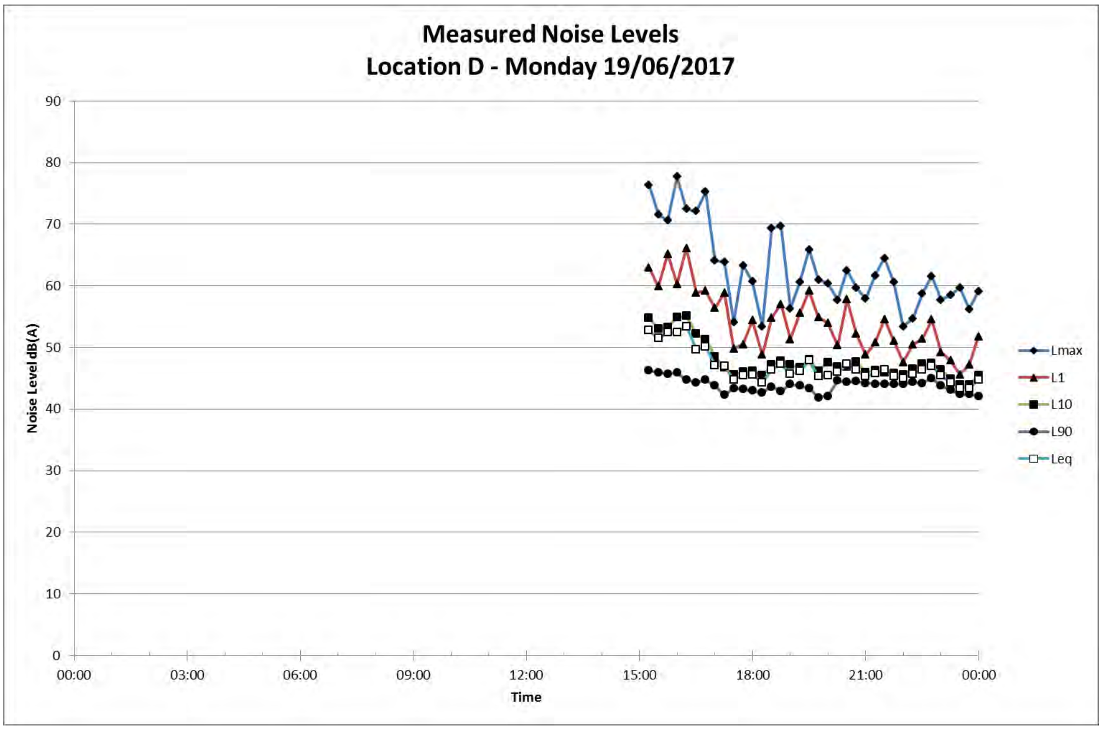
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq



Measured Noise Levels
Location D - Monday 19/06/2017
Noise Level dB(A)
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50
40
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20
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00:00
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12:00
15:00
18:00
21:00
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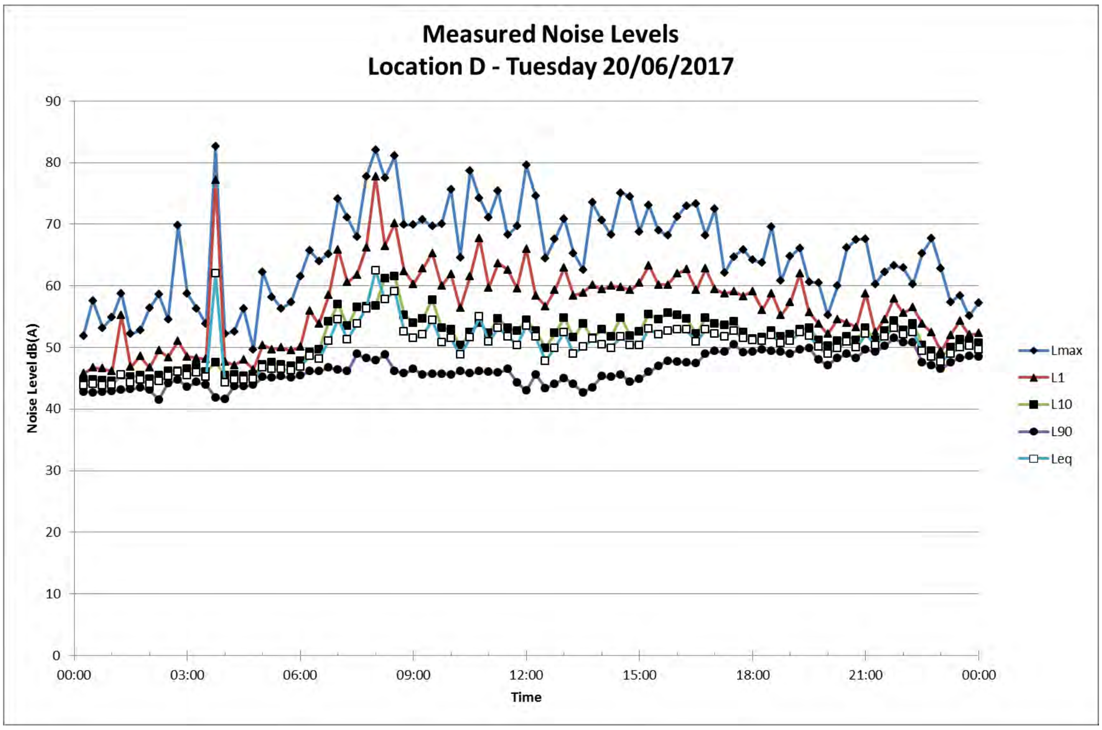
Lmax
L1
L10
L90
Leq



Measured Noise Levels
Location D - Tuesday 20/06/2017
Noise Level dB(A)
Time
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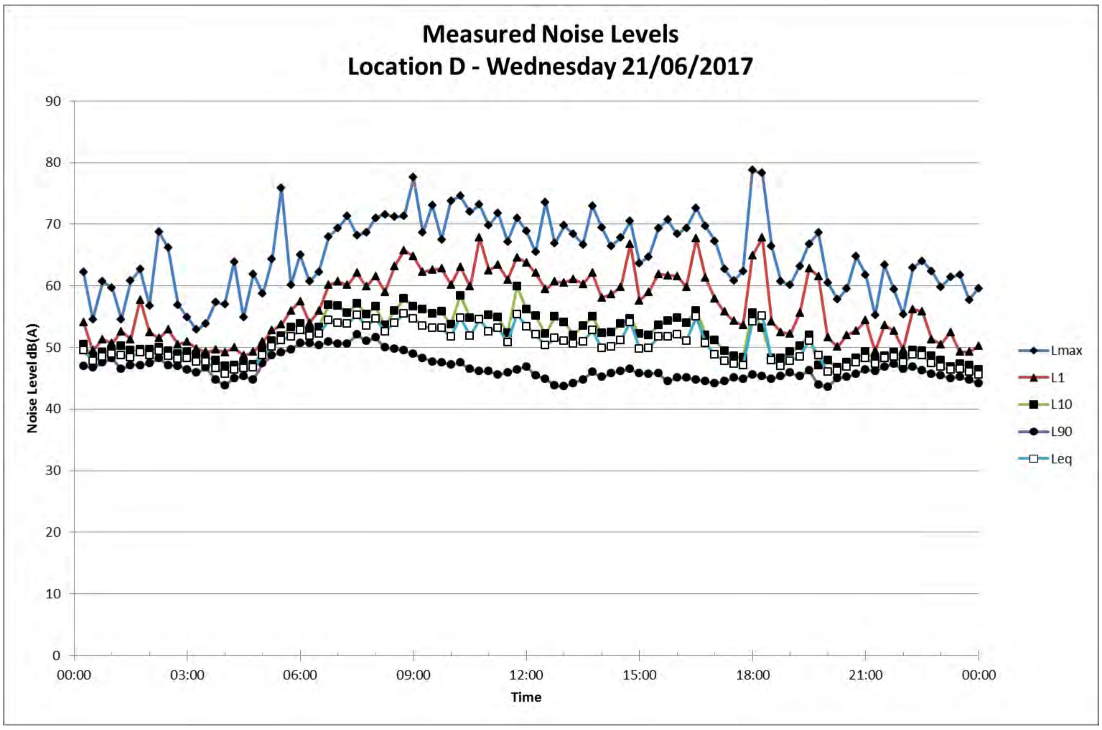
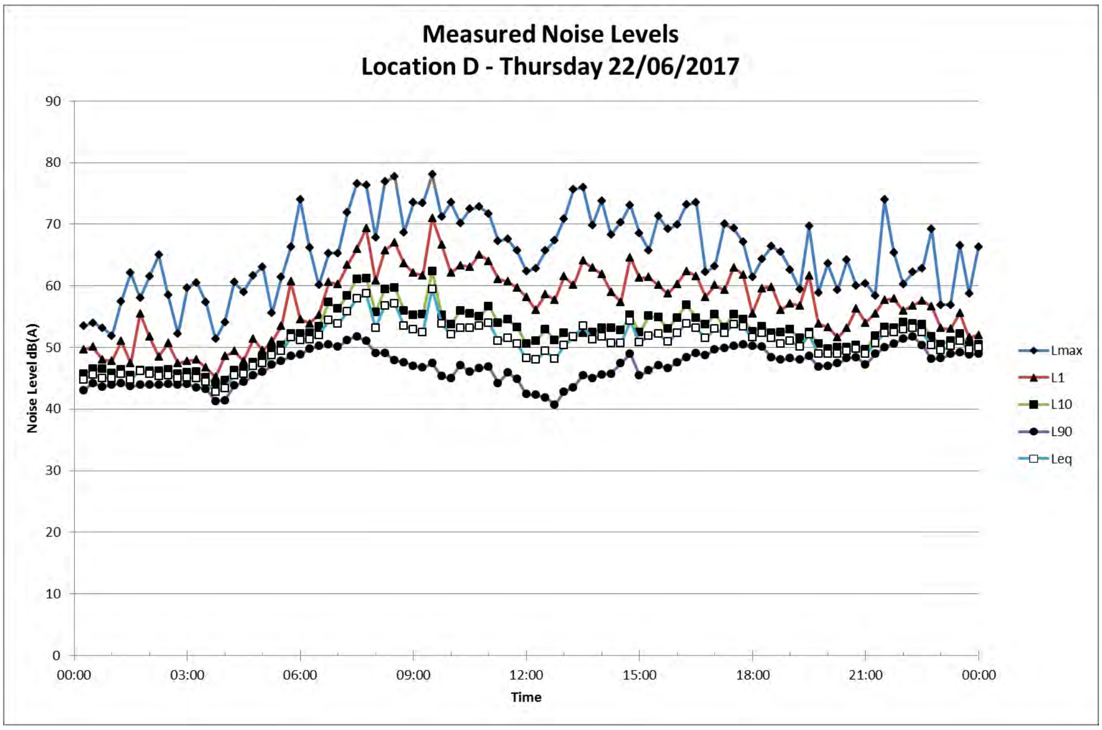
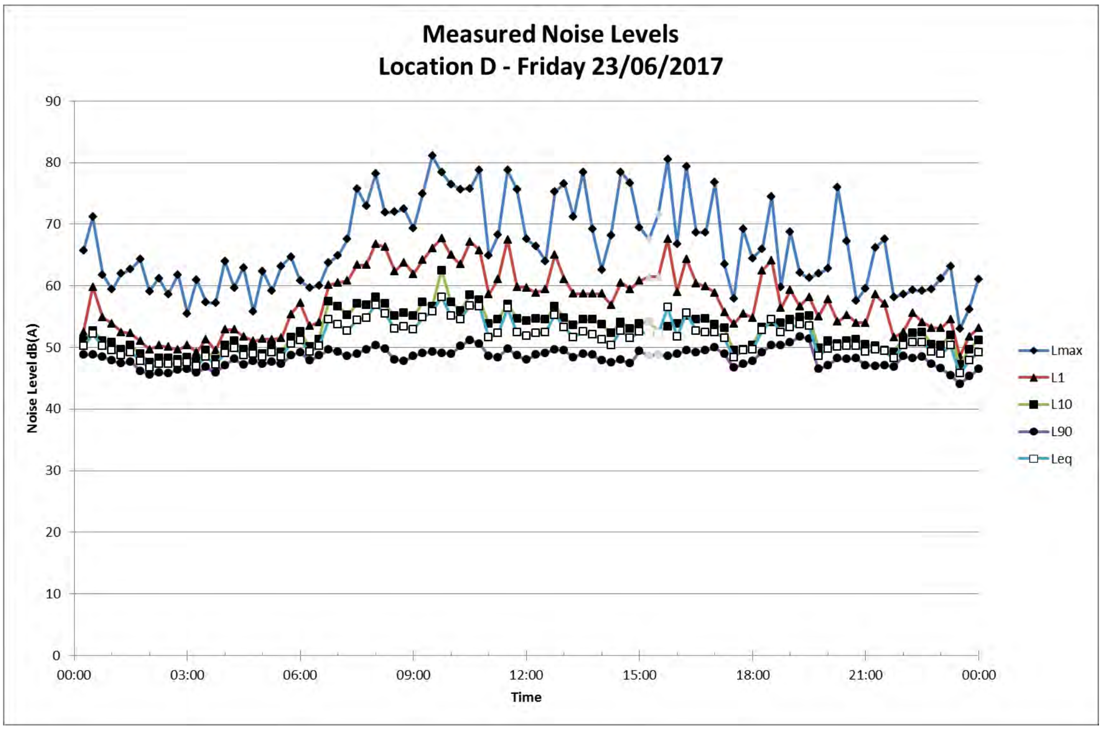

Measured Noise Levels
Location D - Wednesday 21/06/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Location D - Thursday 22/06/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq



Measured Noise Levels
Location D - Friday 23/06/2017
Noise Level dB(A)
Time
0
10
20
30
40
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60
70
80
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00:00
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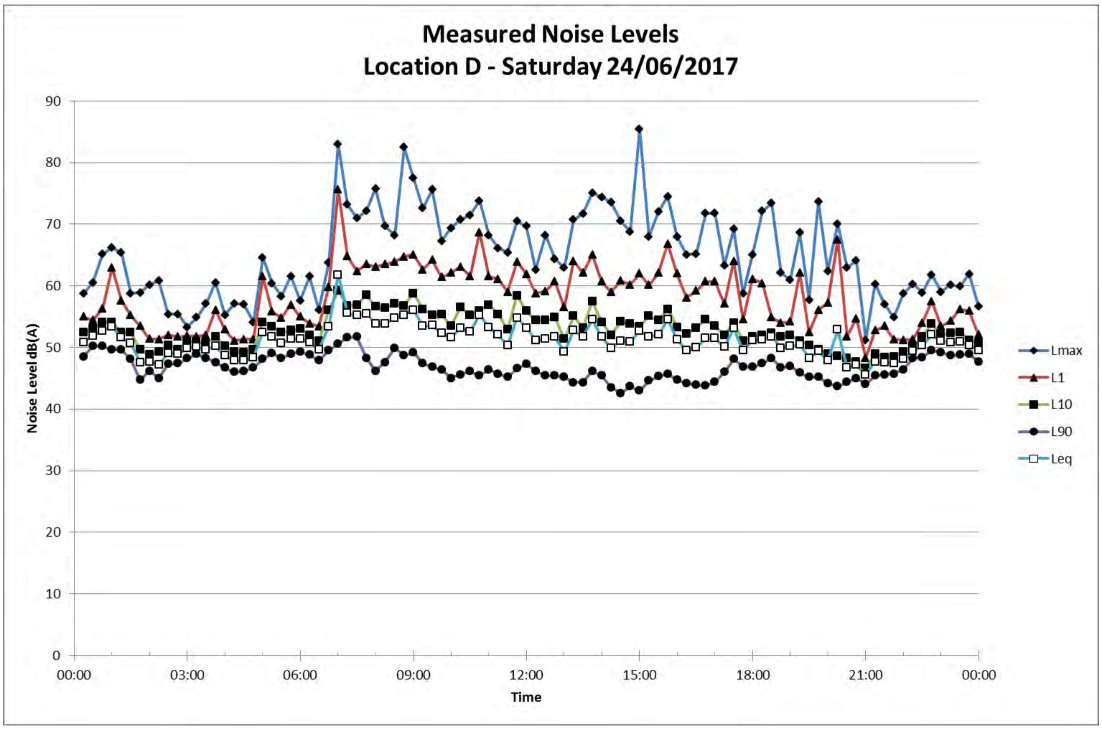
L1
L10
L90
Leq



Measured Noise Levels
Location D - Saturday 24/06/2017
Noise Level dB(A)
Time
0
10
20
30
40
50
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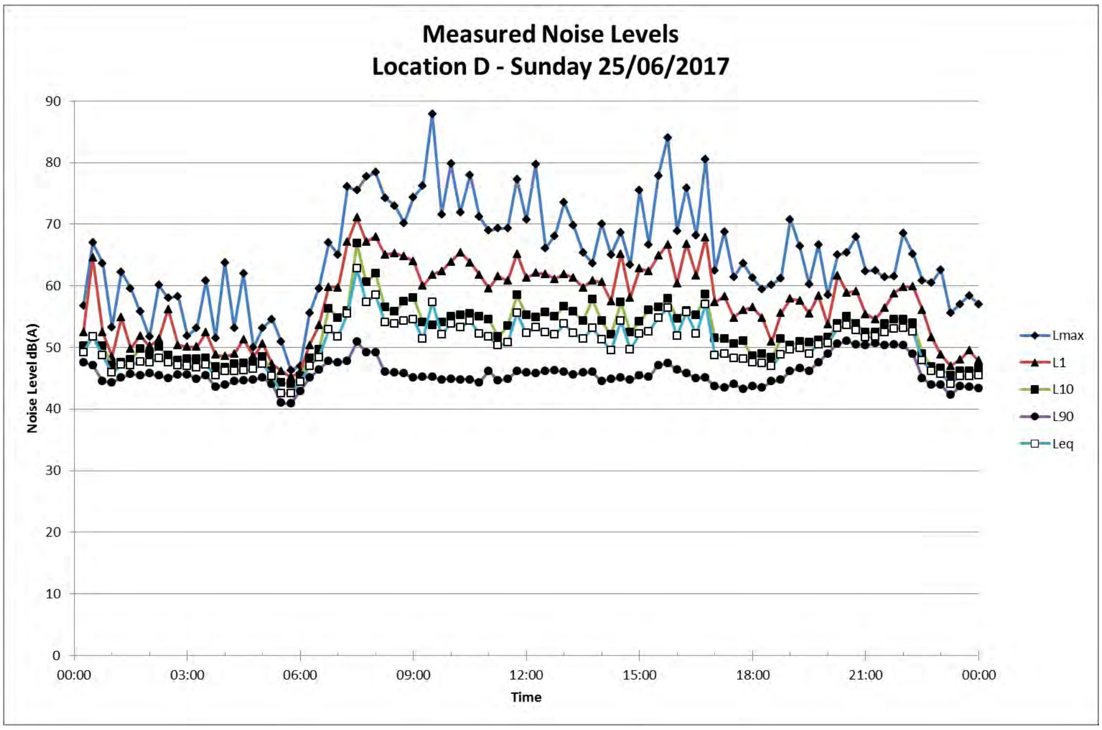
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Location D - Sunday 25/06/2017
Noise Level dB(A)
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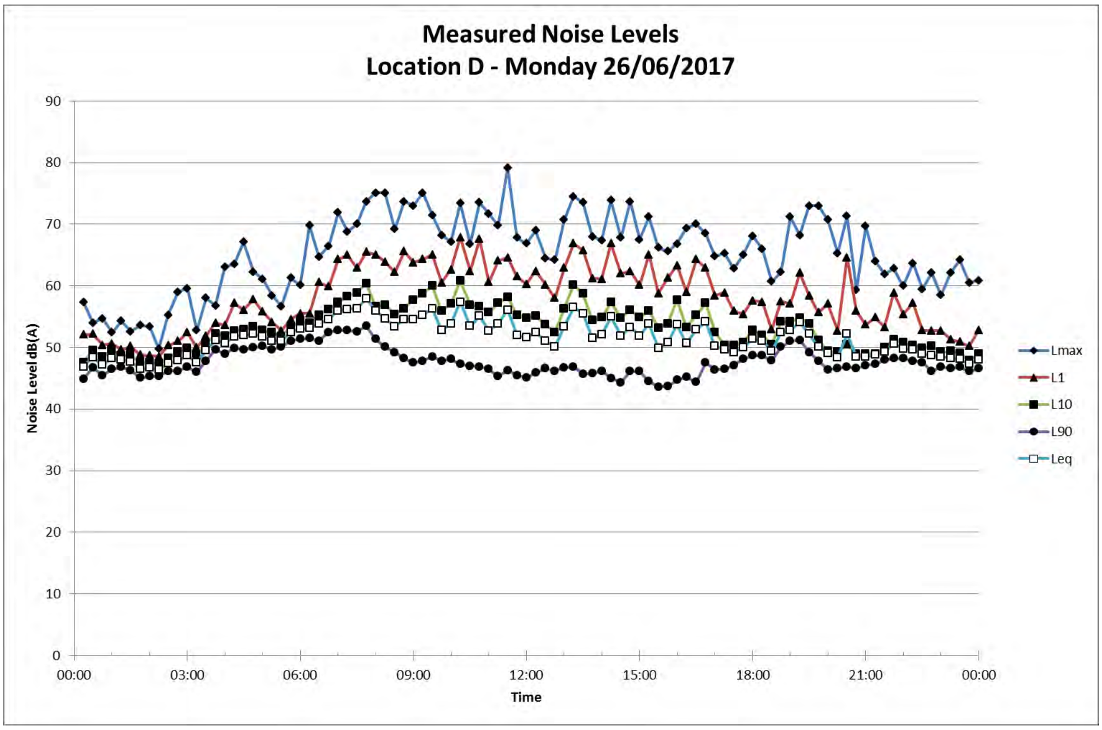
Measured Noise Levels
Location D - Monday 26/06/2017
Noise Level dB(A)
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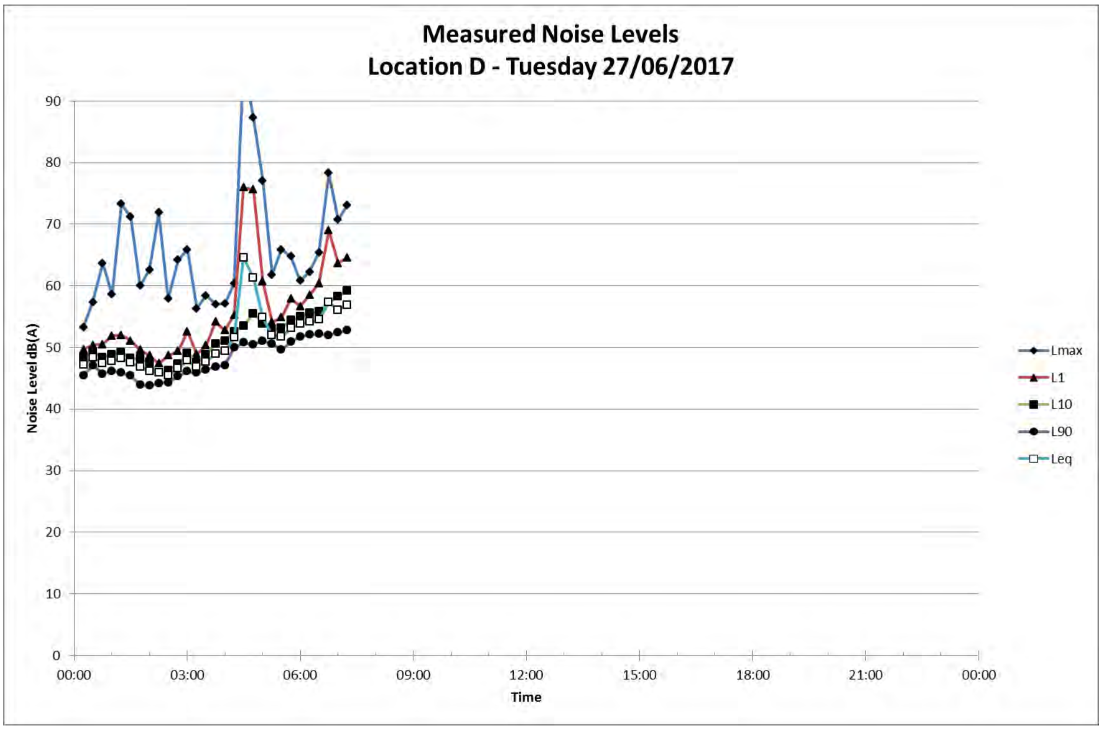

Measured Noise Levels
Location D - Tuesday 27/06/2017
Noise Level dB(A)
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60
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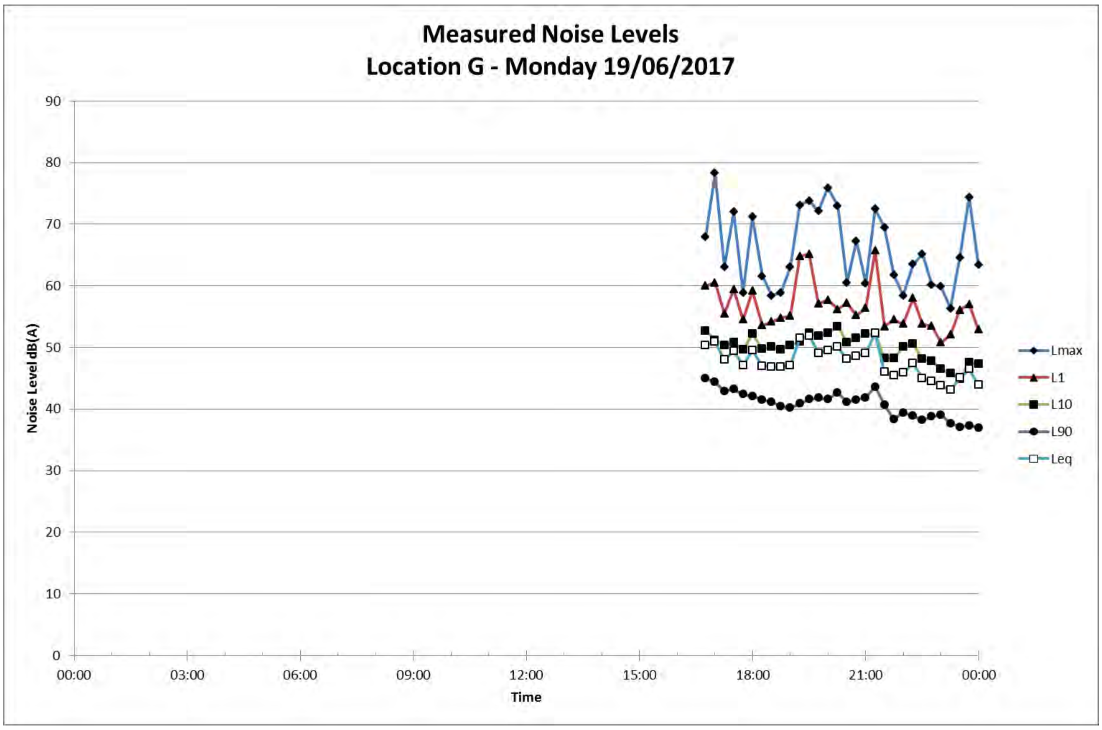

Measured Noise Levels
Location G - Monday 19/06/2017
Noise Level dB(A)
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L1
L10
L90
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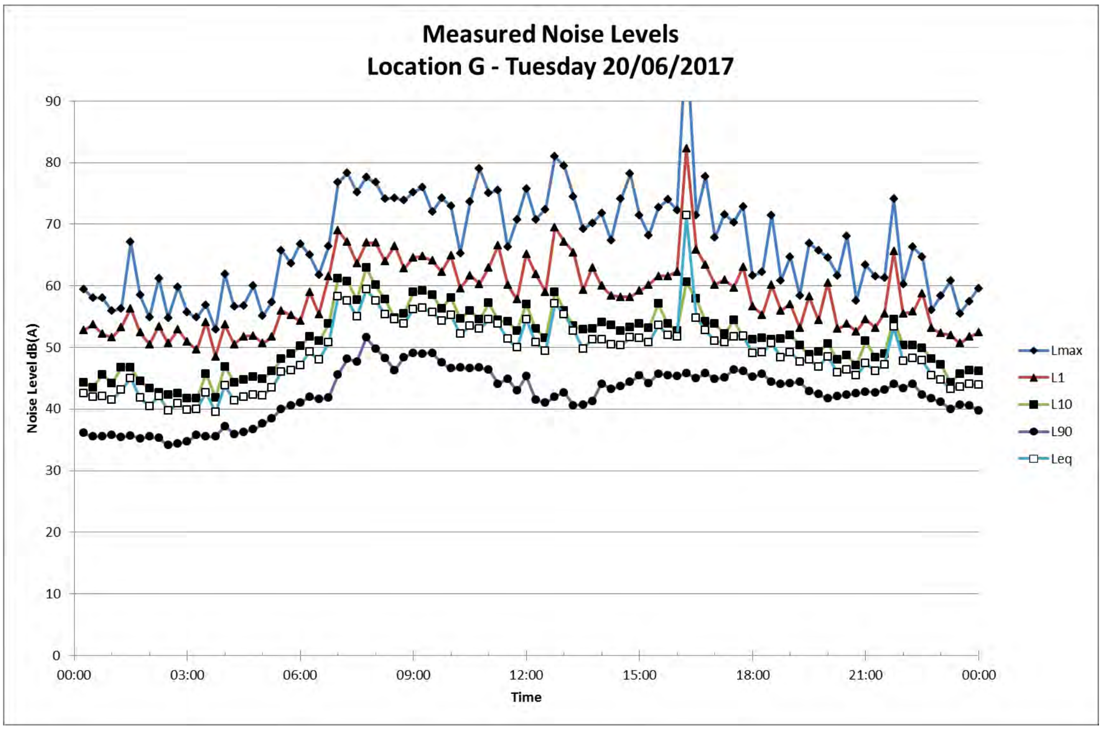

Measured Noise Levels
Location G - Tuesday 20/06/2017
Noise Level dB(A)
Time
Lmax
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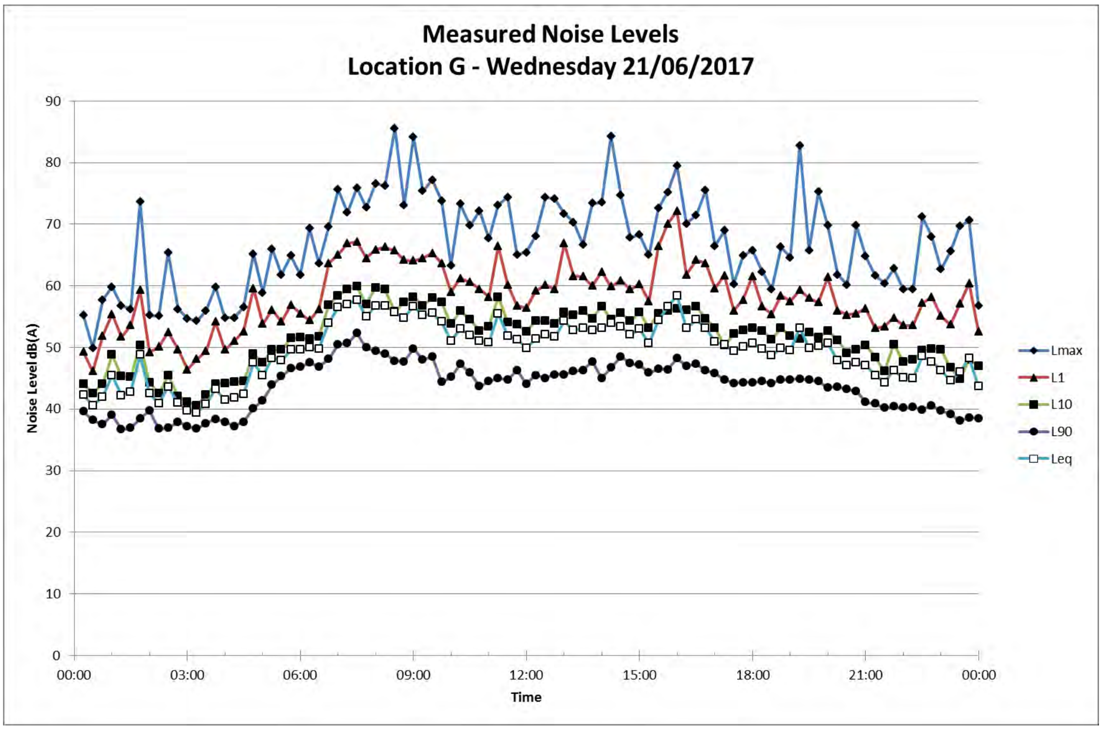
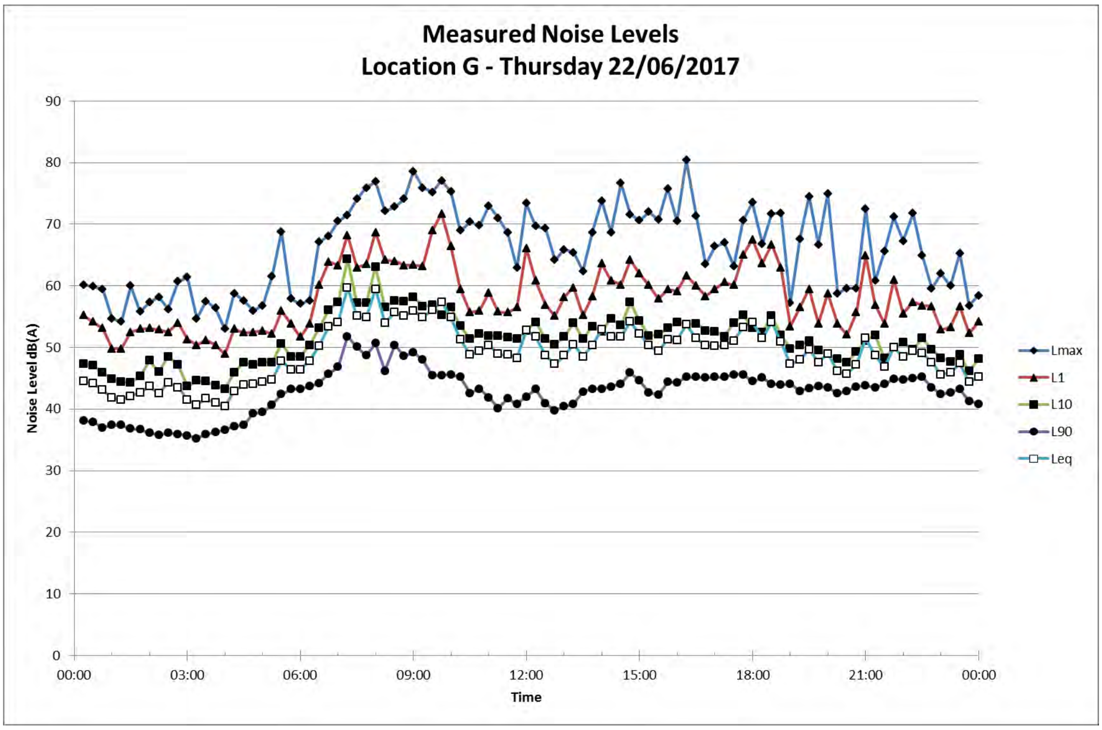
L10
L90
Leq



Measured Noise Levels
Location G - Wednesday 21/06/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Location G - Thursday 22/06/2017
Noise Level dB(A)
Time
Lmax
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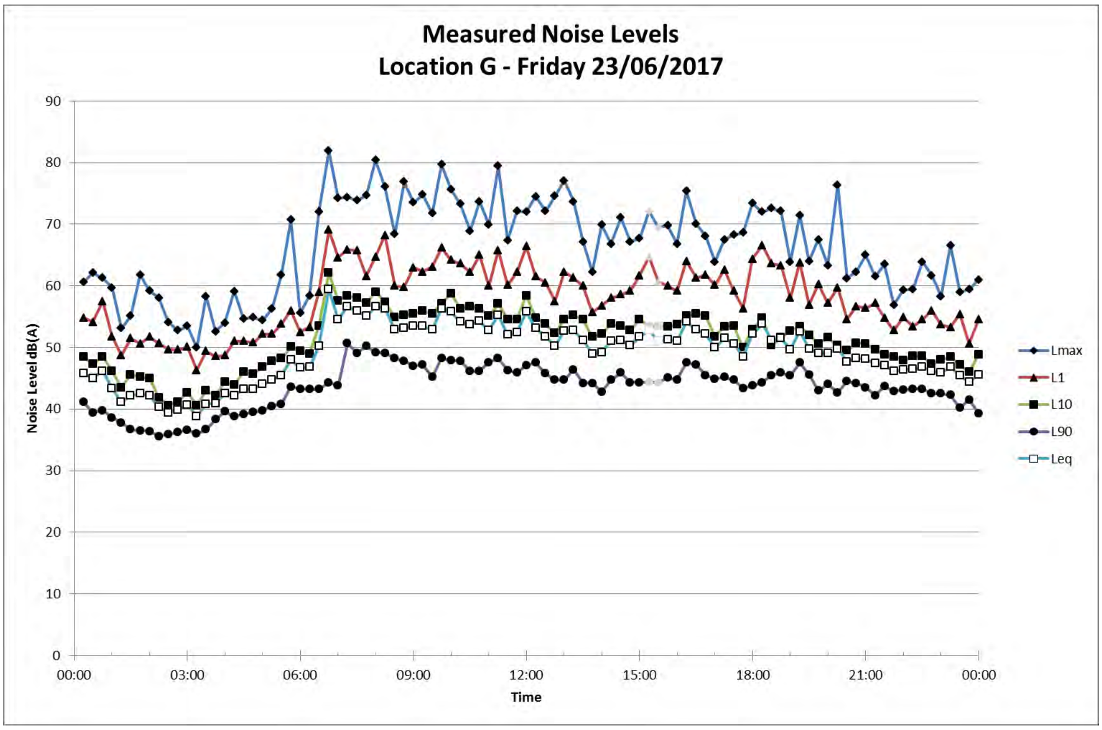
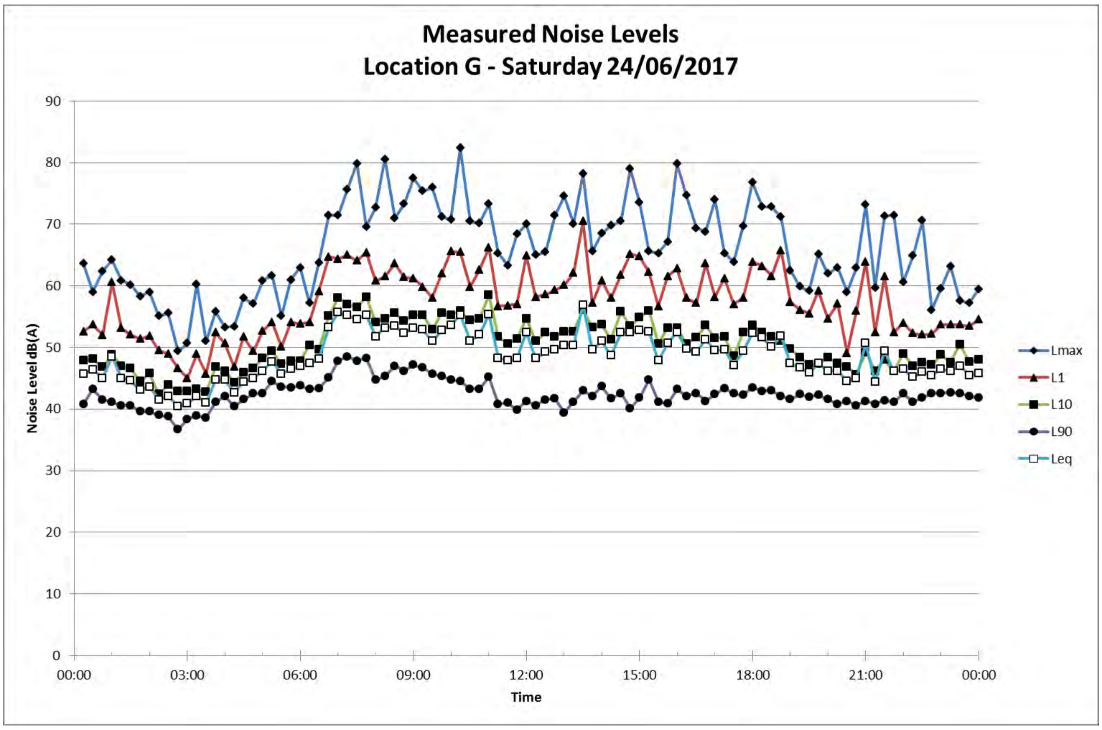
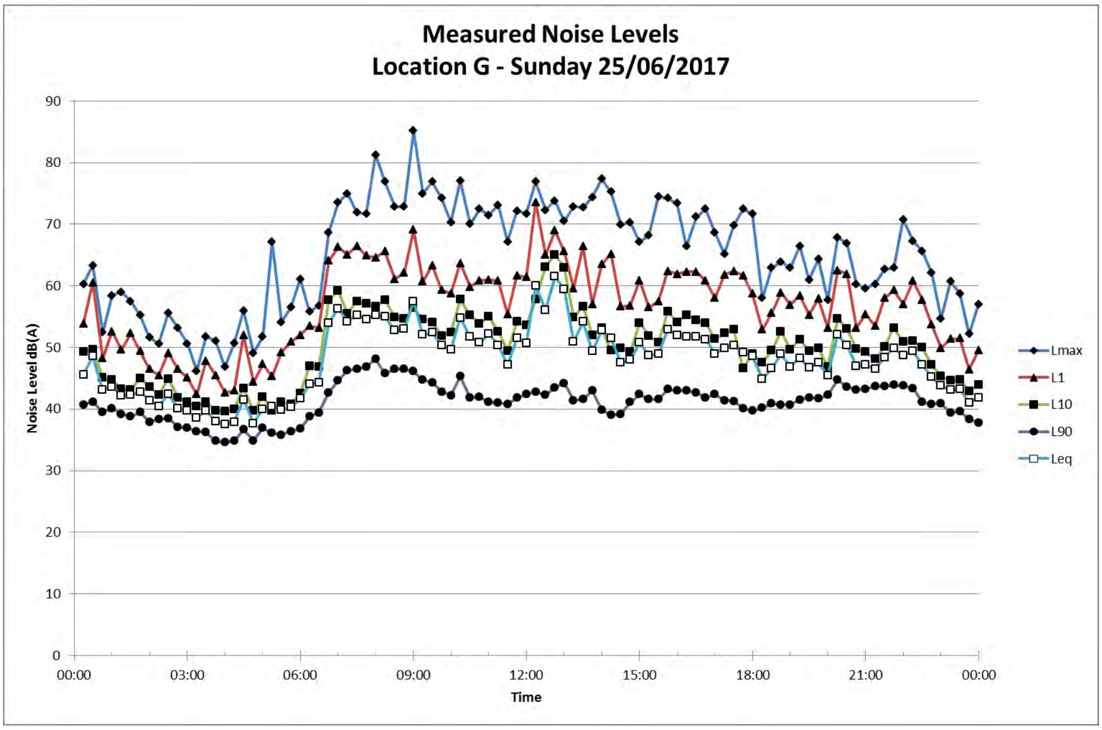
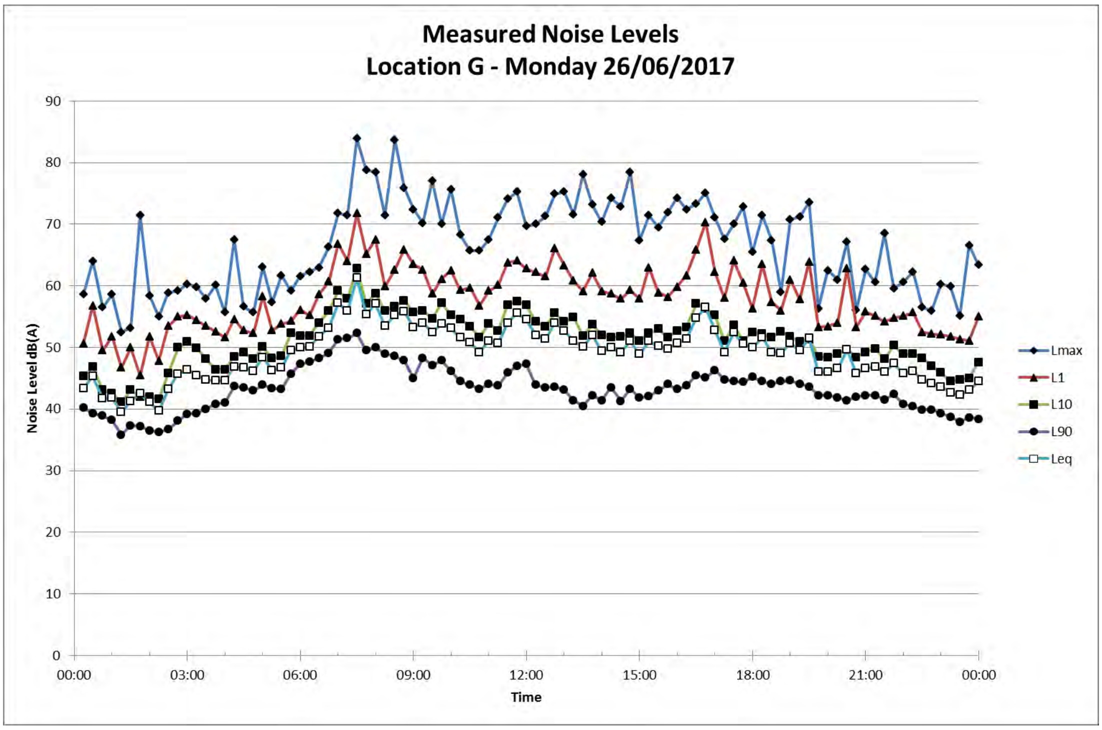
L10
L90
Leq


Measured Noise Levels
Location G - Friday 23/06/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Location G - Saturday 24/06/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq


Measured Noise Levels
Location G - Sunday 25/06/2017
Noise Level dB(A)
Time
Lmax
L1
L10
L90
Leq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Location G - Monday 26/06/2017
Noise Level dB(A)
Time
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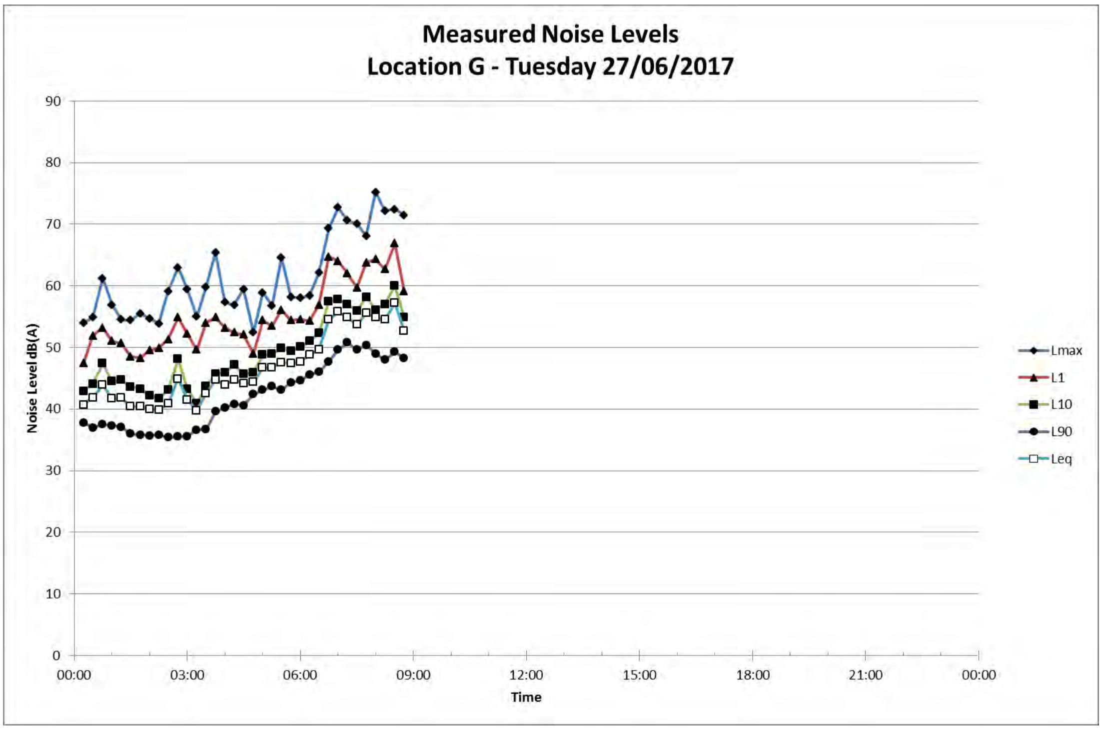
Measured Noise Levels
Location G - Tuesday 27/06/2017
Noise Level dB(A)
Time
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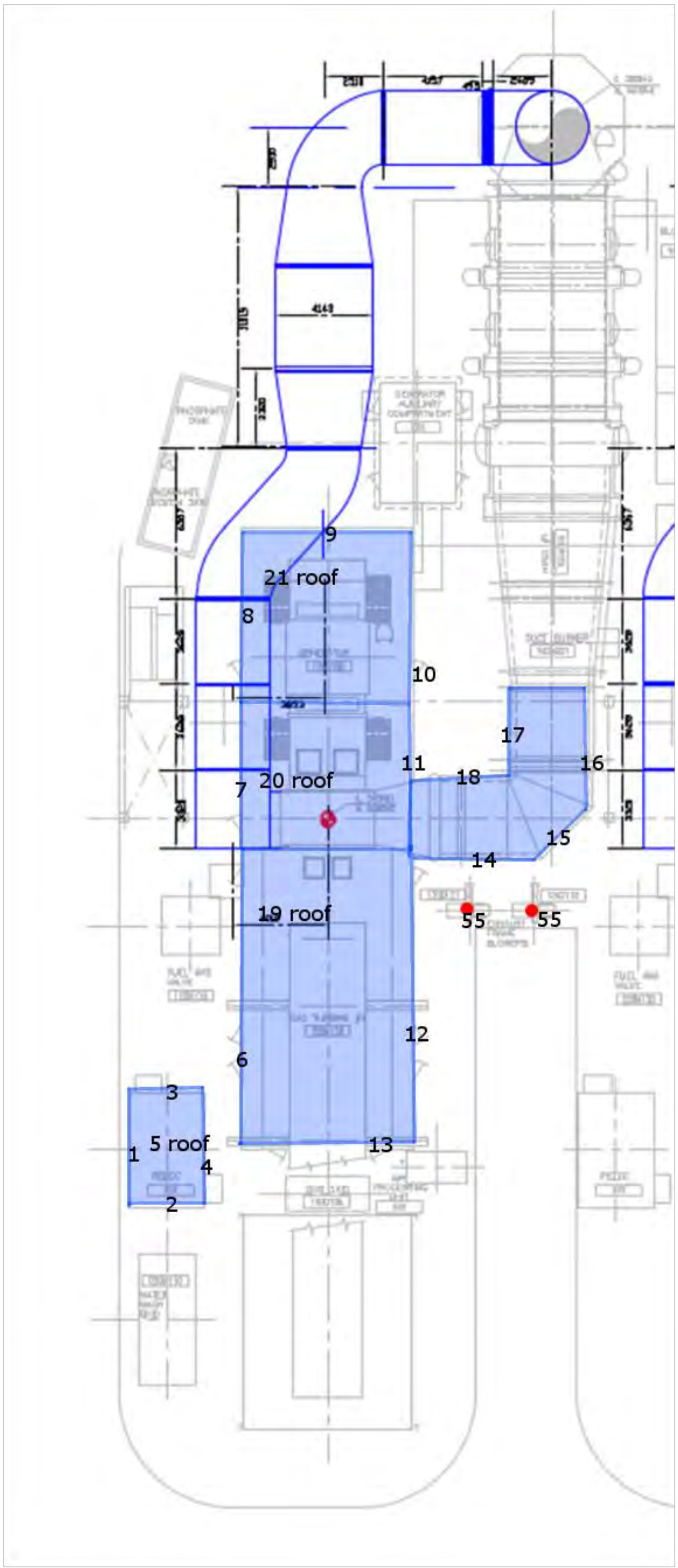
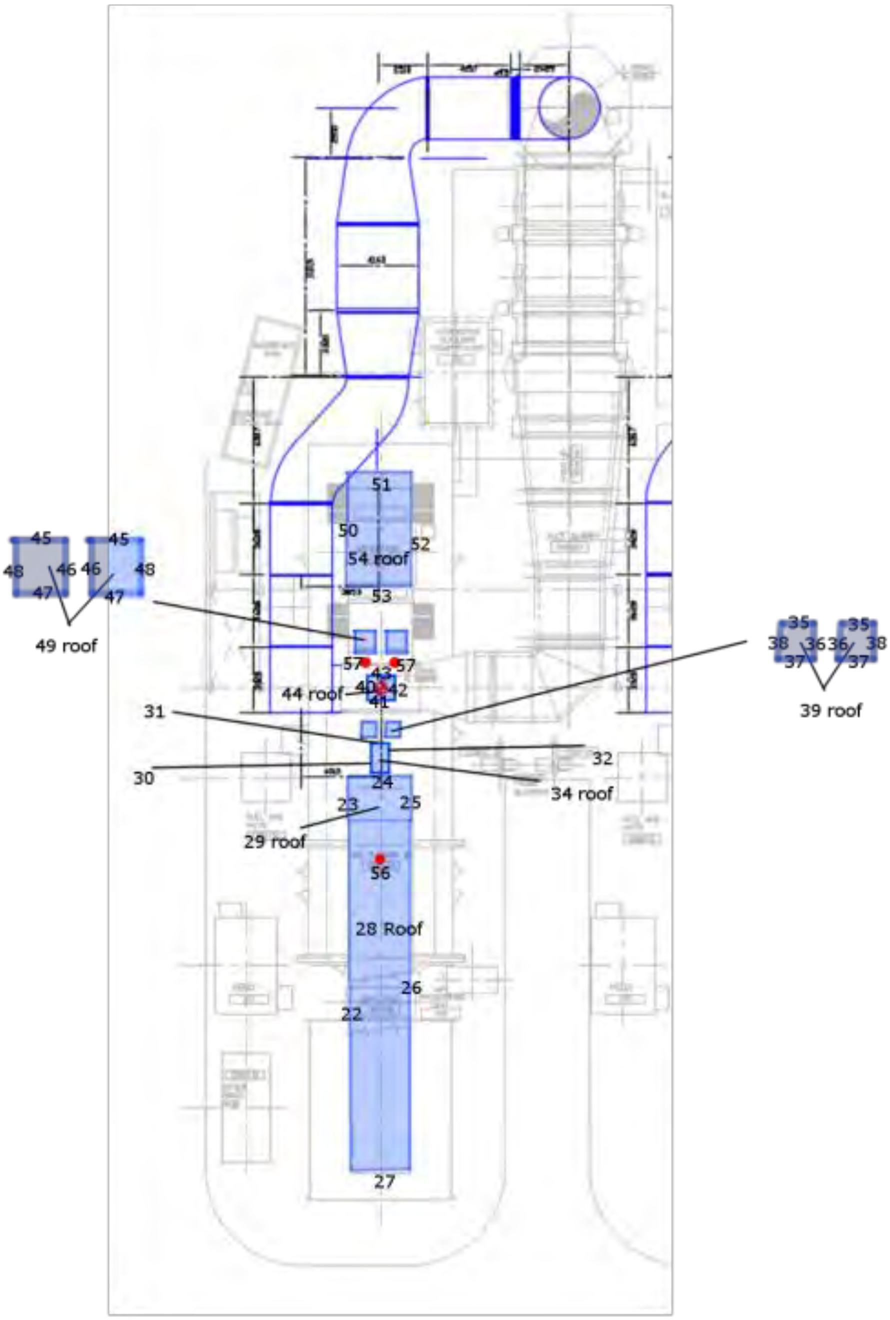
Attachment 5: Noise Model Sources

Noise Source Locations Ground Floor

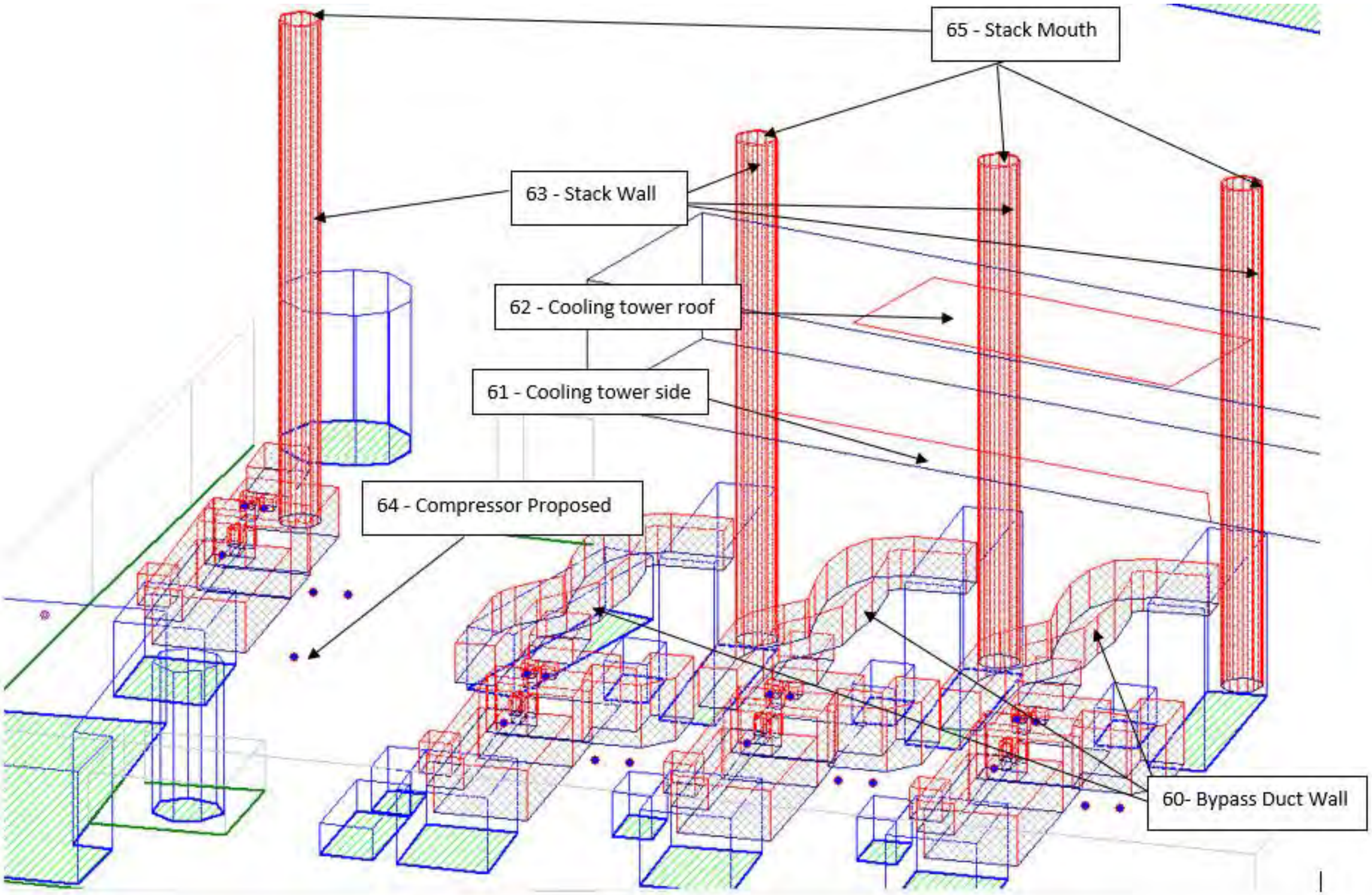


Noise Source Location 1st Floor



Noise Leverl dB(A)

ID	Source Type	Sum	25Hz	31Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz		
1	Area	96	43	48	52	58	58	74	73	71	78	74	73	77	75	78	78	77	78	81	93	83	86	87	83	82	76	76	70		
2	Area	92	43	45	51	55	55	69	69	65	73	69	68	73	71	73	74	73	75	76	88	79	84	83	79	79	74	74	71		
3	Area	92	41	45	49	59	55	70	70	71	77	73	73	77	74	75	77	75	77	78	87	79	83	83	79	79	74	74	67		
4	Area	96	43	48	52	58	58	74	73	71	78	74	73	77	75	78	78	77	78	81	93	83	86	87	83	82	76	76	70		
5	Area	96	43	48	52	58	58	74	73	71	78	74	73	77	75	78	78	77	78	81	93	83	86	87	83	82	76	76	70		
6	Area	90	42	46	50	55	55	70	69	64	71	68	67	71	71	74	73	72	74	76	85	77	82	82	77	77	71	71	65		
7	Area	94	40	44	49	56	55	64	69	67	75	71	70	72	72	76	78	75	77	77	81	84	90	79	81	86	79	75	76		
8	Area	95	49	52	56	66	65	73	81	74	81	78	77	79	79	83	86	83	85	84	84	84	85	82	80	79	75	74	69		
9	Area	73	28	33	40	48	44	51	57	51	56	58	56	58	57	63	60	60	63	63	63	64	64	60	60	58	55	53	49		
10	Area	78	36	39	45	57	50	57	65	58	64	62	63	65	63	70	65	64	67	66	68	66	69	65	61	62	58	57	52		
11	Area	90	46	50	54	67	63	71	78	69	74	73	73	76	74	85	77	76	78	76	80	77	79	75	72	73	70	70	65		
12	Area	84	37	42	46	52	51	61	63	58	64	61	63	67	68	81	69	69	72	68	72	68	75	70	64	64	59	59	54		
13	Area	75	32	36	40	43	44	64	59	51	59	53	54	57	55	63	56	56	58	57	61	57	71	64	56	59	54	51	46		
14	Area	97	47	51	56	62	64	76	75	71	77	75	78	82	81	94	82	82	84	81	86	80	86	82	76	77	71	71	68		
15	Area	99	48	54	59	67	65	76	79	76	84	79	81	86	84	95	83	83	85	84	88	82	89	86	80	80	76	75	73		
16	Area	98	54	56	63	70	71	76	80	76	81	81	81	83	83	94	85	83	85	84	86	84	87	83	80	81	77	75	71		
17	Area	98	54	56	63	70	71	76	80	76	81	81	81	83	83	94	85	83	85	84	86	84	87	83	80	81	77	75	71		
18	Area	98	55	57	61	72	69	75	87	78	83	81	81	84	83	93	84	83	85	84	87	84	87	83	80	80	78	77	73		
19	Area	96	51	52	58	60	63	85	80	70	77	74	75	78	78	87	77	77	78	77	80	78	93	85	76	81	75	73	68		
20	Area	87	36	39	46	54	56	67	74	68	72	67	71	77	72	75	72	72	78	79	78	75	78	74	70	71	65	68	61		
21	Area	87	36	39	46	54	56	67	74	68	72	67	71	77	72	75	72	72	78	79	78	75	78	74	70	71	65	68	61		
22	Area	104	52	56	61	65	68	89	84	75	81	77	79	82	83	97	84	84	86	83	87	85	101	94	83	88	82	80	77		
23	Area	101	47	51	58	63	66	80	79	75	81	76	78	82	80	90	80	82	85	82	85	82	99	92	81	85	78	77	74		
24	Area	100	46	50	57	62	65	79	78	74	80	75	77	81	79	89	79	81	84	81	84	81	98	91	80	84	77	76	73		
25	Area	100	46	50	57	62	65	79	78	74	80	75	77	81	79	89	79	81	84	81	84	81	98	91	80	84	77	76	73		
26	Area	91	39	43	48	52	55	76	71	62	68	64	66	69	70	84	71	71	73	70	74	72	88	81	70	75	69	67	64		
27	Area	91	39	43	48	52	55	76	71	62	68	64	66	69	70	84	71	71	73	70	74	72	88	81	70	75	69	67	64		
28	Area	91	39	43	48	52	55	76	71	62	68	64	66	69	70	84	71	71	73	70	74	72	88	81	70	75	69	67	64		
29	Area	100	46	50	57	62	65	79	78	74	80	75	77	81	79	89	79	81	84	81	84	81	98	91	80	84	77	76	73		
30	Area	85	32	36	43	47	48	69	64	58	63	60	62	64	62	71	65	64	67	65	68	66	82	75	71	75	64	63	68		
31	Area	85	32	36	43	47	48	69	64	58	63	60	62	64	62	71	65	64	67	65	68	66	82	75	71	75	64	63	68		
32	Area	85	32	36	43	47	48	69	64	58	63	60	62	64	62	71	65	64	67	65	68	66	82	75	71	75	64	63	68		
34	Area	83	30	34	41	45	46	67	62	56	61	58	60	62	60	69	63	62	65	63	66	64	80	73	69	73	62	61	66		
35	Area	84	32	38	43	48	49	58	62	65	73	65	67	74	68	72	67	66	72	71	70	68	77	72	70	77	63	63	66		
36	Area	75	22	28	33	38	40	48	52	55	64	55	57	65	58	62	57	57	62	61	60	58	67	62	61	68	53	53	57	64	60
37	Area	84	32	38	43	48	49	58	62	65	73	65	67	74	68	72	67	66	72	71	70	68	77	72	70	77	63	63	66		
38	Area	94	43	47	53	55	56	72	67	68	72	71	73	74	73	80	75	75	79	77	80	77	91	85	79	80	73	71	74	64	60
39	Area	82	33	37	43	46	50	62	63	63	69	64	64	70	67	72	67	66	70	68	69	67	77	71	67	70	62	62	61		
40	Area	93	62	66	70	74	76	77	80	79	80	79	81	80	80	81	81	82	82	81	80	78	83	77	74	72	68	67	61	56	51
41	Area	83	31	37	42	50	54	63	66	68	74	65	66	71	68	74	68	68	70	69	69	67	76	70	68	72	61	61	61		
42	Area	82	32	36	44	52	53	61	64	63	67	63	66	73	67	72	68	68	72	71	71	68	75	69	66	68	61	63	59		
43	Area	84	32	37	46	53	56	61	65	66	72	66	67	74	70	76	72	70	75	74	72	70	74	69	66	67	62	64	57		
44	Area	84	32	37	46	53	56	61	65	66	72	66	67	74	70	76	72	70	75	74	72	70	74	69	66	67	62	64	57		
45	Area	81	33	37	47	54	52	57	67	66	70	66	65	70	66	72	68	66	70	69	69	68	71	67	64	65	60	60	55		
46	Area	76	26	31	39	45	47	54	66	62	65	59	58	67	62	67	63	62	65	65	63	62	67	62	59	60	55	58	50		
47	Area	85	32	37	46	52	54	61	70	67	72	66	68	78	71	74	70	70	77	75	73	70	74	69	66	66	62	68	57		
48	Area	96	60	64	67	69	72	75	87	77	81	79	75	81	82	83	83	83	85	85	85	85	86	82	80	82	81	81	70	62	58
49	Area	76	26	31	39	45	47	54	66	62	65	59	58	67	62	67	63	62	65	65	63	62	67	62	59	60	55	58	50		
50	Area	79	35	36	41	50	48	55	67	58	65	68	62	65	63	68	68	67	69	68	68	67	70	66	64	63	59	58	53		
51	Area	82	37	39	50	54	53	62	70	66	71	65	64	69	66	72	70	68	71	69	69	68	73	68	65	65	61	61	55		
52	Area	80	35	36	43	50	49	58	68	59	65	65	62	66	64	71	66	66	69	67	68	67	72	67	64	64	60	59	55		
53	Area	76	36	38	44	50	48	50	59	53	59	63	59	63	61	68	64	64	66	65	66	67	66	63	62	61	57	54	50		
54	Area	80	35	36	43	50	49	58	68	59	65	65	62	66	64	71	66	66	69	67	68	67	72	67	64	64	60	59	55		
55	Point	101	44	49	57	60	63	66	76	75	74	83	78	82	86	87	97	86	86	89	85	91	86	91	89	84	82	77	76	68	62
56	Point	102	51	54	61	62	67	83	75	66	72	72	73	77	78	83	79	80	80	78	80	82	101	93	80	87	80	77	70	64	56
57	Point	91	41	45	52	58	61	73	86	72	72	70	72	78	73	75	75	76	81	80	79	77	82	77	73	74	70	70	61	55	50
58	Point	96	34	31	33	40	49	52	59	68	67	64	66	75	78	75	73	79	76	78	82	83	92	90	84	82	79	81	76	72	70
59	Point	90	38	41	48	49	55	70	62	54	59	59	61	64	66	71	67	68	67	65	68	70	88	81	68	74	68	65	57	52	44



65 - Stack Mouth
63 - Stack Wall
62 - Cooling tower roof
61 - Cooling tower side
64 - Compressor Proposed
60- Bypass Duct Wall

Noise Leverl dB(A)

ID	Source Type	Sum	25Hz	31Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz	12.5kHz	16kHz	20kHz
60	Area	71	8	16	27	32	41	49	54	49	54	65	62	65	60	59	59	59	57	57	53	56	56	44	43	42	29	22	10	14		
61	Area	96	34	31	33	40	49	52	59	68	67	64	66	75	78	75	73	79	76	78	82	83	92	90	84	82	79	81	76	72	70	39
62	Area	90	38	41	48	49	55	70	62	54	59	59	61	64	66	71	67	68	67	65	68	70	88	81	68	74	68	65	57	52	44	
63	Area	71	8	16	27	32	41	49	54	49	54	65	62	65	60	59	59	59	57	57	53	56	56	44	43	42	29	22	10	14		
64	Point	102	40	45	53	60	63	72	73	75	76	83	93	83	88	96	91	89	94	90	90	88	87	85	85	78	75	71	64	60	53	44

ID	Source Type	Sum	31Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	16kHz
65	Area	105	72	88	95	102	100	95	85	77	62	38