STATELINE ASPHALT BATCHING PLANT
NOISE AND VIBRATION IMPACT ASSESSMENT
133 SOMERSBY FALLS ROAD, SOMERSBY NSW 2250

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Stateline Asphalt Pty Ltd
Central Coast Council
NSW Environment Protection Agency
NSW Department of Planning and Environment

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EXECUTIVE SUMMARY

Benbow Environmental has been engaged by Stateline Asphalt Pty Ltd to prepare a Noise and Vibration Impact Assessment for an asphalt batching plant at 133 Somersby Falls Road, Somersby NSW 2250 (Lot 2 DP712505 This report has been completed as part of an Environmental Impact Statement (EIS) for the proposed development. It was prepared after the issue of the Secretary's environmental assessment requirements (SEARs) number 1655.

The proposed development includes installation of an asphalt mixing plant with a capacity to produce approximately 200 tonnes of asphalt per hour would generate up to 200,000 tonnes of new asphalt material per annum. This noise report assesses contributions from the proposed asphalt plant operations.

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

Operational noise is predicted to comply with the Noise Policy for Industry (2017) criteria at all residential receptors with the noise controls presented in Section 7.4.

The predicted noise levels associated with construction exceed the noise management level at residential receivers R1 and R13, compliance is achieved at all other receivers. None of the predicted noise levels exceed the highly noise affected management level of 75 dB(A). Standard construction hours and universal work practices are recommended.

The site is predicted to comply with the Road Noise Policy.

Vibration impacts from the proposed asphalt batching plant are considered negligible.

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1. INTRODUCTION

Benbow Environmental has been engaged by Stateline Asphalt Pty Ltd to prepare a Noise and Vibration Impact Assessment for an asphalt batching plant at 133 Somersby Falls Road, Somersby NSW 2250 (Lot 2 DP712505). This report has been completed as part of an Environmental Impact Statement (EIS) for the proposed development. It was prepared after the issue of the Secretary's environmental assessment requirements (SEARs) number 1655.

The proposed development includes installation of an asphalt mixing plant with a capacity to produce approximately 200 tonnes of asphalt per hour would generate up to 200,000 tonnes of new asphalt material per annum.

The asphalt plant would consist of several components including a control system, vibrating screens, dryers, burners, mixers, weighing equipment, aggregate storage and hot storage silos for bitumen with circulation and supply equipment. The plant would also be equipped with a dust collection system to capture any dust generated by the process. The plant would be designed so that the individual components are concealed from public view to maintain visual amenity of the area. The company is currently in discussions with suppliers to determine the most effective options for plant design.

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

- NSW Noise Policy for Industry (EPA, 2017);
- NSW Interim Construction Guideline (DECCW, 2009);
- NSW Road Noise Policy (RNP) (DECCW, 2011);
- British Standard BS 7385–Part 2: 1993 '*Evaluation and measurement for vibration in buildings*';
- German standard DIN4150–Part 3: 1999 '*Structural Vibration Part 3 – effects of vibration on structures*'; and
- The *Assessing Vibration – A Technical Guideline* (DEC, 2006).

1.1 Scope of Works

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

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

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

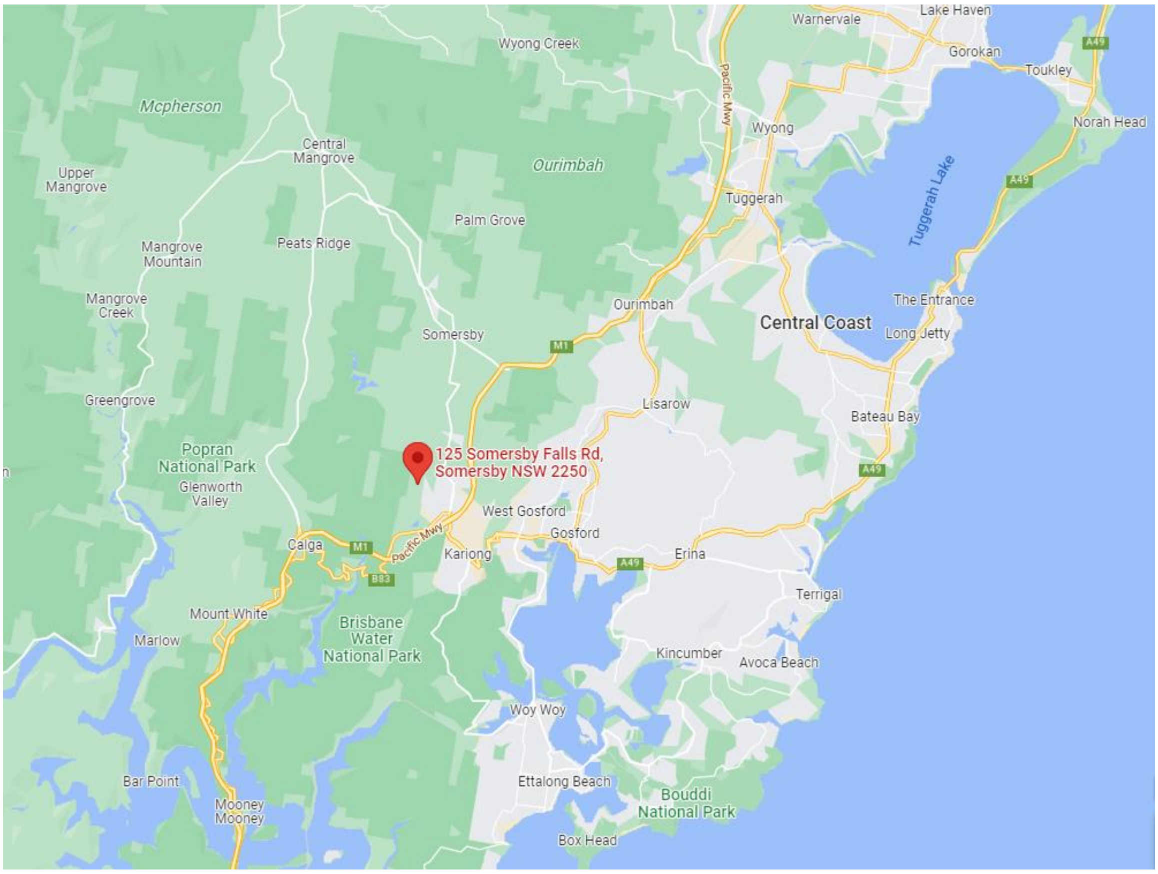
2. LOCATION AND SETTING

2.1 SITE LOCATION

The site is located at 133 Somersby Falls Road, Somersby NSW 2250. It is legally designated as Lot 2 DP712505. The site is located within an industrial and rural area, which is surrounded by other industry buildings to the north, east and south a large expanse of flora, fauna and waterways to the west and further around the industrial area.

It is a 1 ha lot trapezoidal in shape and can be accessed from Somersby Falls Road. The site is situated in IN1 – General Industrial land use zoning under the Central Coast Local Environmental Plan (LEP) 2022, though it is noted that the entirety of the address and lot number are also partly designated as RU1 – Primary Production. It is located at the edge of an industrial precinct, adjacent receptors are industrial, rural and environmental. Figure 2-1 shows the site in a regional context., Figure 2-2 shows the site and the surrounding area.

Figure 2-1: Site Location in a regional context



Source: Google Maps 2022

↑N Not to scale		Benbow Environmental 27 Sherwood Street, Northmead NSW 2152

Figure 2-2: Site and Surrounding Area

Source: Google Earth 2020

↑N Not to scale		Benbow Environmental 27 Sherwood Street, Northmead NSW 2152

2.2 HOURS OF OPERATIONS

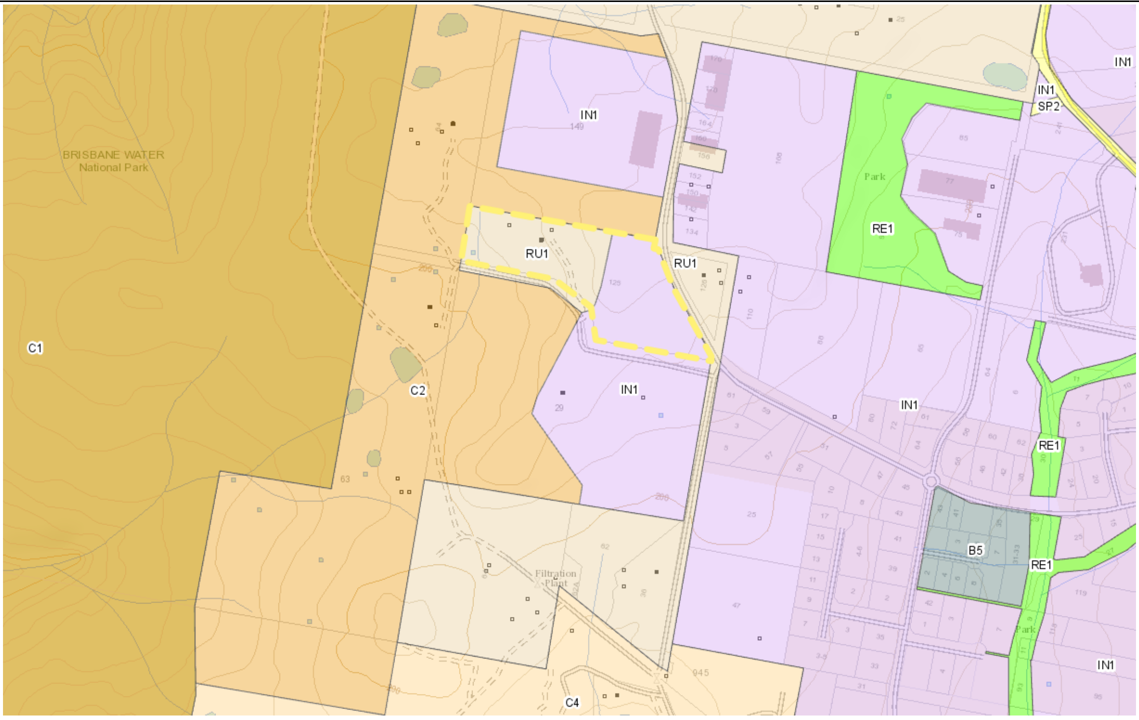
The proposed facility will operate during the daytime period (7am to 6pm) from Monday to Friday. It will not operate on the weekend or on Public Holidays.

2.3 DESCRIPTION OF THE SURROUNDING AREA

The site and remaining areas within the lot number are located within land zoned IN1 – General Industrial and RU1 – Primary Production under the Central Coast Local Environment Plan 2022. Immediately surrounding the lot are RU1 to the east, C2 – Environmental Conservation to the north, west and south and IN1 to the south also. Further surrounds are IN1 to north, east, and south, RU1 to the north and south, C1 – National Parks and Nature Reserves to the west and C4 – Environmental Living to the south. The land zoning map is shown below in Figure 2-3.

Note: A reference to an Environment Protection zone E1, E2, E3 or E4 within a Land Zoning Map should be taken to be a reference to a Conservation zone C1, C2, C3 or C4. For further information please see Standard Instrument (Local Environmental Plans) Amendment (Land Use Zones) Order 2021.

Figure 2-3: Land Zoning Map



Source: : ePlanning Spatial Viewer 2022

↑N

Not to scale

LEGEND:

Zone

- B1 Neighbourhood Centre
- B2 Local Centre
- B3 Commercial Core
- B4 Mixed Use
- B5 Business Development
- B6 Enterprise Corridor
- E1 National Parks and Nature Reserves
- E2 Environmental Conservation
- E3 Environmental Management
- E4 Environmental Living
- IN1 General Industrial
- IN4 Working Waterfront
- R1 General Residential
- R2 Low Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU1 Primary Production
- RU2 Rural Landscape
- RU3 Forestry
- RU5 Village
- SP1 Special Acitivites
- SP2 Infrastructure

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2.4 Nearest Sensitive Receptors

Table 2-1 provides the list of the nearest identified receptors that have the potential to be affected by the processes at the subject site. These receptors were selected based on their proximity and directional bearing from the subject site.

Figure 2-4 shows an aerial of the site and nearest sensitive receptors.

Table 2-1: Nearest Potentially Affected Receivers Considered

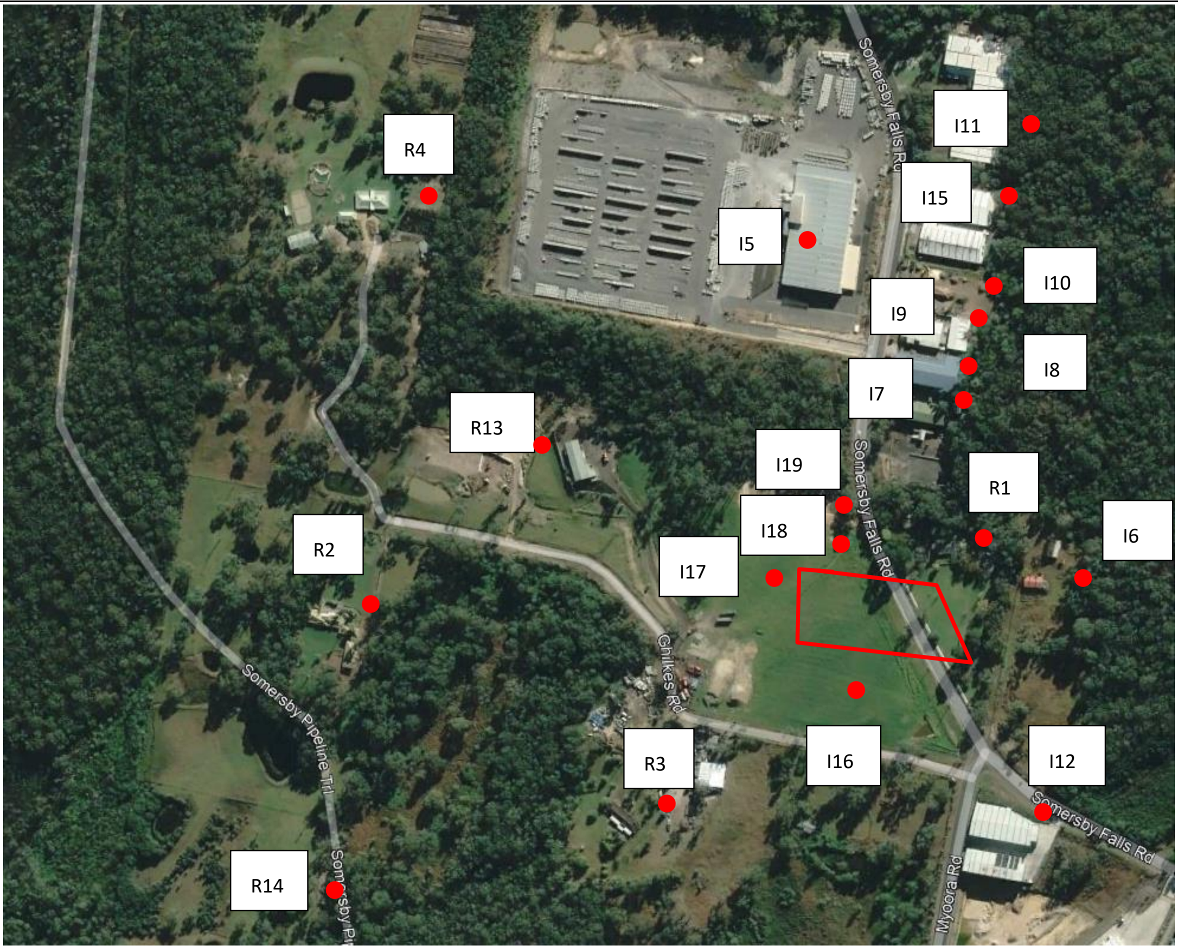
Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Development	Direction from Site	Type of Receptor
R1	126 Somersby Falls Road, Somersby	1/ DP712505	35 m	E	Residential
R2	63 Ghilkes Road Somersby	502/ DP712506	350 m	W	Residential
R3	29 Ghilkes Road, Somersby	3/ DP712505	60 m	S	Residential/ Commercial
R4	64 Ghilkes Road, Somersby	501/ DP712506	340 m	NW	Residential/ Commercial
I5	149 Somersby Falls Road, Somersby	4/ DP654894	160 m	N	Industrial
I6	110 Somersby Falls Road, Somersby	1/ DP510364	60 m	E	Industrial
I7	134 Somersby Falls Road, Somersby	1/ DP787857	140 m	NE	Industrial
I8	142 Somersby Falls Road, Somersby	2/ DP787857	200 m	NE	Industrial
I9	150 Somersby Falls Road, Somersby	3/ DP787857	240 m	NE	Industrial
I10	156 Somersby Falls Road, Somersby	91/ DP546768	305 m	NE	Industrial
I11	170 Somersby Falls Road	7/ DP787857	435 m	NE	Industrial
I12	2/61 Somersby Falls Road, Somersby	29/ DP1093201	130 m	S	Industrial
R13	125 Somersby Falls Road, Somersby	5/ DP1292653	229 m	NW	Residential/ Rural Landscape
R14	63 Ghilkes Road, Somersby	502/ DP712506	590 m	SW	Residential/ Environmental Conservation
I15	164 Somersby Falls Road, Somersby	6/ DP787857	363 m	NE	Industrial

Table 2-1: Nearest Potentially Affected Receivers Considered

Receptor ID	Address	Lot & DP	Approx. Distance from Proposed Development	Direction from Site	Type of Receptor
I16	129 Somersby Falls Road, Somersby	4/ DP1292653	30 m	S	Industrial
I17	125 Somersby Falls Road, Somersby	5/ DP1292653	48 m	W	Industrial
I18	139 Somersby Falls Road, Somersby	2/ DP1292653	35 m	N	Industrial
I19	145 Somersby Falls Road	1/ DP1292653	50 m	N	Industrial

Note: distances measured from the boundaries of the site

Figure 2-4: Aerial Photograph of the Project Site Location and the Nearest Potentially Affected Receptors



Source: Google Earth 2022

↑N Not to scale	LEGEND: Site Receptor	Benbow Environmental 27 Sherwood Street Northmead NSW 2152

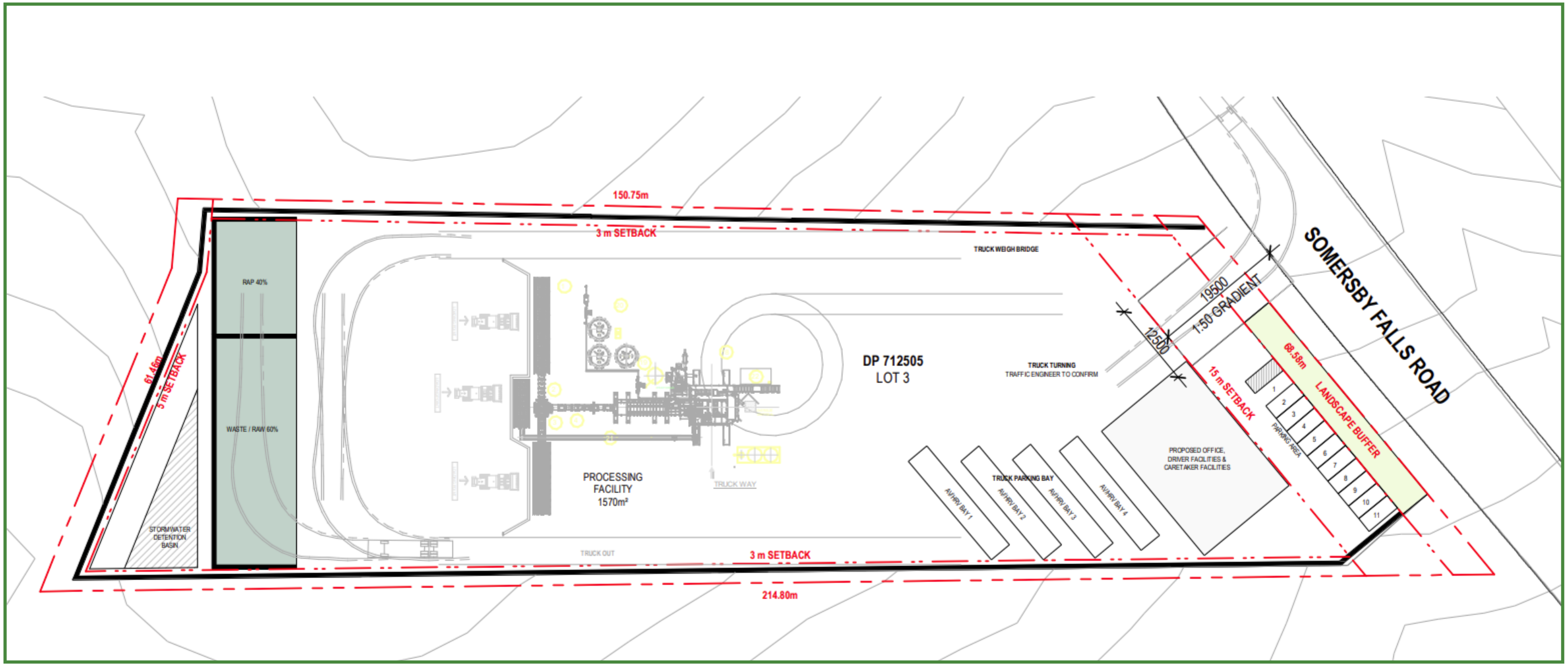
3. PROPOSED DEVELOPMENT

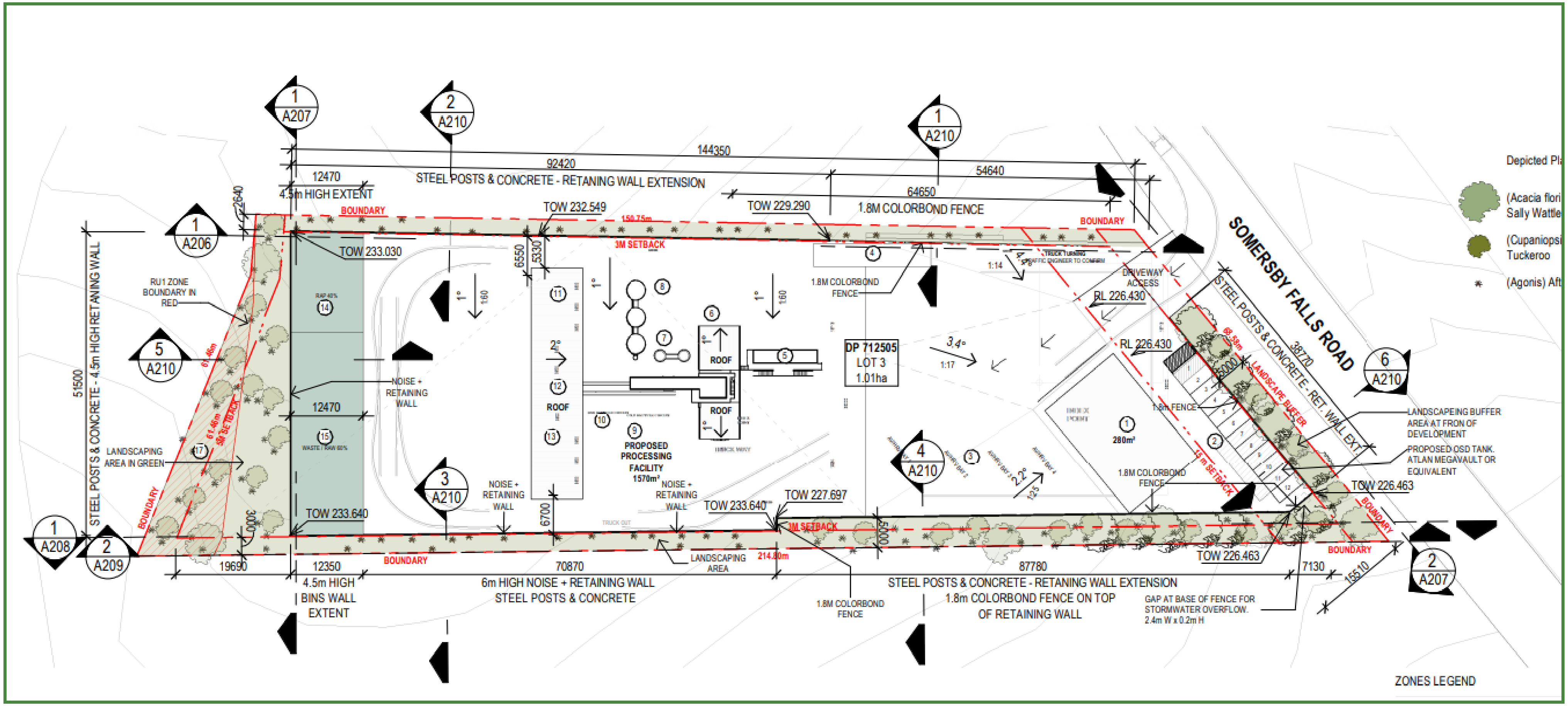
The proposed development includes the construction and operation of an asphalt batching plant that will produce up to 200,000 tonnes per annum (tpa), a RAP storage yard, office and depot.

The asphalt batching plant produces coated roadstone, such as asphalt concrete, using a variety of aggregates, sand, and filler materials in precise proportions. The facility receives pre-crushed RAP and aggregate. The RAP is then combined with new materials in the correct proportions and heated in a drum dryer. A binder, bitumen, is added to the mixture, and the temperature is carefully controlled to ensure the final product is workable.

The plant has several components, including a cold aggregate supply system, this is fed from storage bays via front end loader into hoppers, a drum dryer, a dust collector, a hot aggregate elevator, a vibrating screen, a filler supply system, a weighing and mixing (pugmill) system, a pollution control unit, asphalt storage, and a bitumen supply system. The quality of the asphalt produced is affected by each of these components, as well as the proportion of recycled asphalt used.

Figure 3-1: Site Plan




SOMERSBY FALLS ROAD
STEEL POSTS & CONCRETE - RETANING WALL EXTENSION
4.5m HIGH EXTENT
1.8M COLORBOND FENCE
TOW 232.549
TOW 229.290
TOW 233.030
TOW 233.640
TOW 227.697
TOW 226.463
RL 226.430
3M SETBACK
BOUNDARY
RU1 ZONE BOUNDARY IN RED
LANDSCAPING AREA IN GREEN
STEEL POSTS & CONCRETE - 4.5m HIGH RETANING WALL
NOISE + RETAINING WALL
PROPOSED PROCESSING FACILITY 1570m²
ROOF
DP 712505 LOT 3 1.01ha
DRIVEWAY ACCESS
LANDSCAPEING BUFFER AREA AT FRON OF DEVELOPMENT
PROPOSED OSD TANK. ATLAN MEGAVAULT OR EQUIVALENT
STEEL POSTS & CONCRETE - RET WALL EXT
4.5m HIGH BINS WALL EXTENT
6m HIGH NOISE + RETAINING WALL STEEL POSTS & CONCRETE
LANDSCAPING AREA
1.8m COLORBOND FENCE ON TOP OF RETAINING WALL
GAP AT BASE OF FENCE FOR STORMWATER OVERFLOW. 2.4m W x 0.2m H
144350
92420
54640
64650
12470
51500
19690
12350
70870
87780
7130
15510
38770
ZONES LEGEND

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 the daytime, evening and night time periods. The Noise Policy for Industry defines these periods as follows:

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

4.1 NOISE MONITORING EQUIPMENT AND METHODOLOGY

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

To ensure accuracy and reliability in the results, field reference checks were applied both before and after the measurement period with an acoustic calibrator. There were no excessive variances observed in the reference signal between the pre-measurement and post-measurement calibration. The instruments were set on A-weighted Fast response and noise levels were measured over 15-minute statistical intervals. QA/QC procedures applied for the measurement and analysis of noise levels have been presented in Attachment 3. The microphones were fitted with windsocks and were positioned between 1.2 metres and 1.5 metres above ground level. Details of the instrumentation and setting utilised are provided in Table 4-1.

Table 4-1: Noise Monitoring Locations

Location	Type of Monitoring	Serial Number	Address
A	Unattended and attended monitoring	87823C	126 Somersby Falls Road, Somersby
B	Unattended and attended monitoring	194552	29 Ghilkes Road, Somersby

4.2 MEASUREMENT LOCATION

Unattended long-term noise monitoring was undertaken from 30th November 2022 to 9th December 2022 at two representative locations, as shown in Figure 4-1. The logger at the site location captured the existing road noise also.

Attended noise monitoring was undertaken at the same locations on 30th November 2022.

Figure 4-1: Noise Logging Locations

Source: Six Maps 2019

↑N Not to scale	**Legend**: Noise logging and Attended location ● Site Boundaries ▭	Benbow Environmental 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 Noise Policy for Industry. That is, the ABL is established by determining the lowest tenth-percentile level of the L_{A90} noise data over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night assessment periods is based on the median of individual ABL's determined over the entire monitoring period.

The results of the long-term unattended noise monitoring are displayed in Table 4-2. Daily noise logger graphs have been included in Attachment 4.

Table 4-2: Unattended Noise Monitoring Results Location A, dB(A)

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
30/11/2022	66	58	56	58	50	54	43	41	41	78	52	53
1/12/2022	64	62	56	54	53	48	43	42	39	56	56	51
2/12/2022	65	56	56	56	50	50	45	41	40	55	52	51
3/12/2022	58	56	52	49	47	45	38	38	33	50	53	46
4/12/2022	58	57	49	49	51	43	34	40	32	51	54	44
5/12/2022	64	64	53	53	57	45	37	43	33	54	60	48
6/12/2022	64	57	54	55	50	47	44	41	40	54	52	49
7/12/2022	65	61	54	53	53	46	35	34	31	54	59	49
8/12/2022	64	57	54	54	49	46	42	42	35	54	51	49
9/12/2022	68	-	55	56	-	48	44	-	34	56	-	51
Average	**64**	**59**	**54**	**54**	**51**	**47**	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**42**	**41**	**35**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**68**	**55**	**50**

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

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

Date	Average L_1			Average L_{10}			ABL (L_{90})			L_{eq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
30/11/2022	60	51	46	50	44	42	30	38	36	74	46	48
1/12/2022	51	48	46	44	45	42	37	39	34	44	43	42
2/12/2022	52	50	49	46	46	45	39	39	36	45	45	44
3/12/2022	55	49	50	48	45	44	34	35	35	57	45	45
4/12/2022	52	49	48	44	46	43	33	37	31	45	45	43
5/12/2022	53	54	48	45	49	43	35	41	34	45	49	43
6/12/2022	54	50	48	46	46	45	35	36	38	45	45	44
7/12/2022	52	52	49	44	48	43	35	36	34	44	46	44
8/12/2022	54	49	49	47	44	44	38	39	35	46	43	44
9/12/2022	56	-	48	45	-	42	35	-	33	62	-	42
Average	**54**	**50**	**48**	**46**	**46**	**43**	*	*	*	*	*	*
Median (RBL)	*	*	*	*	*	*	**35**	**38**	**34**	*	*	*
Logarithmic Average	*	*	*	*	*	*	*	*	*	**64**	**45**	**44**

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

4.3.2 Short-Term Attended Noise Monitoring Results

Given that the results of the unattended noise monitoring are affected by all ambient noise sources such as local fauna, road traffic and industrial sources, it is not possible to determine with precision the exact existing industrial noise contribution based on unattended monitoring alone. Therefore, the attended noise monitoring allows for a more detailed understanding of the existing ambient noise characteristics and a more meaningful final analysis to be undertaken. The results of the short-term attended noise monitoring are displayed in Table 4-4.

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

Location / Time	Address	Noise Descriptor				Comments
		L_{Aeq}	L_{A90}	L_{A10}	L_{A1}	
Location A 30/11/2022 16:47 Daytime Period	126 Somersby Falls Road, Somersby	52	44	57	63	*Cars < 62 dB(A)* *Distant Traffic < 50 dB(A)* *Wind, < 51 dB(A)* *Birds< 49 dB(A)* *Machinery < 49 dB(A)*
Location B 30/11/2022 17:35 Daytime Period	29 Ghilkes Road, Somersby	47	39	49	58	*Cars < 57 dB(A)* *Trucks < 55 dB(A)* *Wind, < 51 dB(A)* *Birds< 65 dB(A)* *Helicopter < 65 dB(A)* *Plane <49 dB(A)*

4.3.3 Existing Road Traffic Noise

Existing road traffic noise levels have been obtained from the unattended environmental noise logger located at the site 126 Somersby Falls Road.

Table 4-5 shows the results of the long term unattended road traffic noise monitoring. Daily noise logger graphs have been included in Attachment 4.

Table 4-5: Existing Road Traffic Noise Data for Location A

Date	Existing Road Traffic Noise – dB(A)			
	Daytime (7am to 10pm)		Nightime (10pm to 7am)	
	$L_{eq\ (15\ hour)}$	$L_{eq\ (1\ hour)}$	$L_{eq\ (9\ hour)}$	$L_{eq\ (1\ hour)}$
30/11/2022	78	80	51	51
1/12/2022	56	57	47	50
2/12/2022	55	56	50	51
3/12/2022	48	50	45	46
4/12/2022	48	51	41	44
5/12/2022	55	56	45	48
6/12/2022	54	54	47	49
7/12/2022	54	55	45	48
8/12/2022	54	54	46	49
9/12/2022	57	57	45	47
Overall LEq	54	55	46	49

*excluding 30/11/2022

Based on the results of the noise logging undertaken, the road traffic noise levels measured on Somersby Falls road for day time $L_{eq\ (1\ hour)}$ of 55 dB(A) and night time $L_{eq\ (1\ hour)}$ of 49 dB(A).

5. METEOROLOGICAL CONDITIONS

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

A site-representative meteorological data file was obtained from the Bureau of Meteorology (BOM) for the Mangrove Mountain AWS NSW (AWS ID 061375), approximately 11 km away from the site. In this Section, an analysis of the 2019 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.

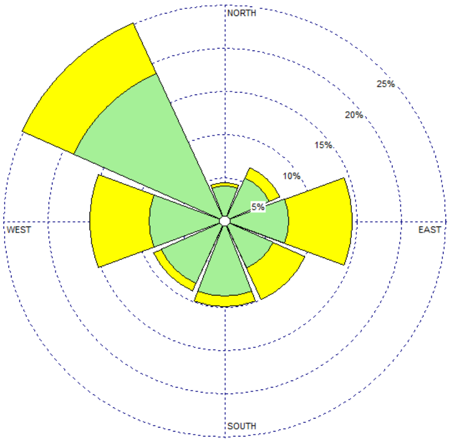
The concentric circles in each wind rose are the axis, which denote frequencies. In comparing the plots it should be noted that the axis varies between wind roses, although all wind roses are similar in size. The frequencies denoted on the axes are indicated beneath each wind rose.

5.1.2 Local Wind Trends

Seasonal wind rose plots for this site utilising Mangrove Mountain AWS 2019 data have been included in Figure 5-1, Figure 5-2 and Figure 5-3 for day, evening and night periods respectively.

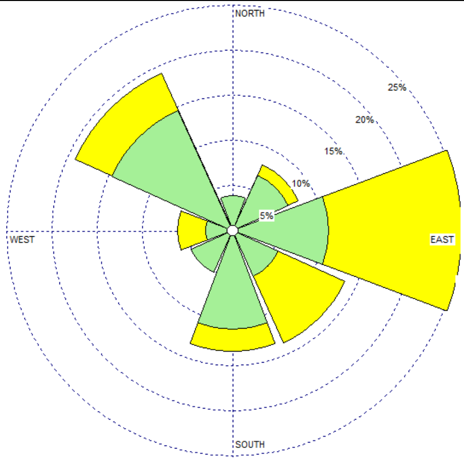
Figure 5-1: Wind Rose Plots – BOM Mangrove Mountain AWS ID 061375 – 2019 – Day time

All Seasons



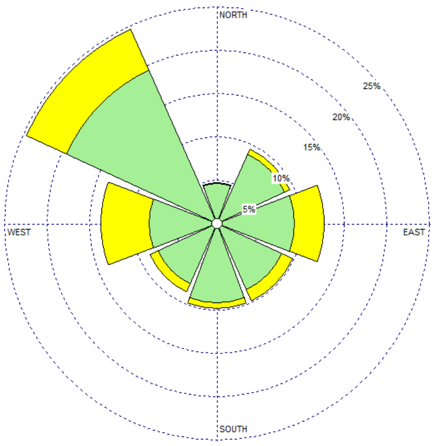
Average Wind Speed: 2.32 m/s
Calms Frequency: 5.17%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Summer Season (December – February)



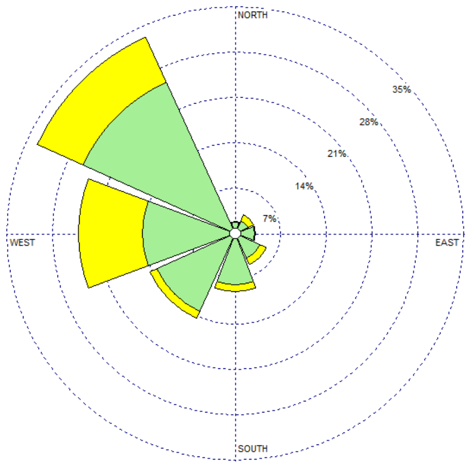
Average Wind Speed: 2.44 m/s
Calms Frequency: 4.72%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Autumn Season (March – May)



Average Wind Speed: 2.04 m/s
Calms Frequency: 5.97%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

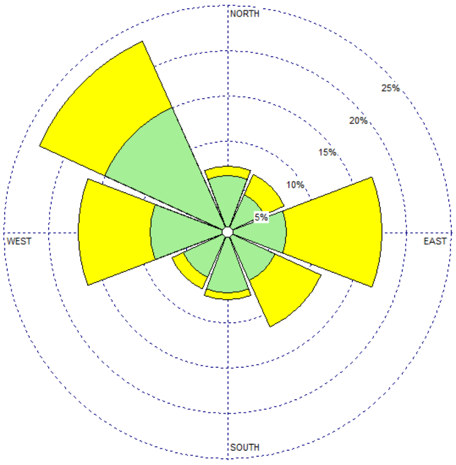
Winter Season (June – August)



Average Wind Speed: 2.16 m/s
Calms Frequency: 5.38%
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Spring Season (September – November)

Legend



Average Wind Speed: 2.64 m/s

Calms Frequency: 2.58%

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

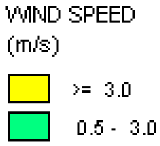
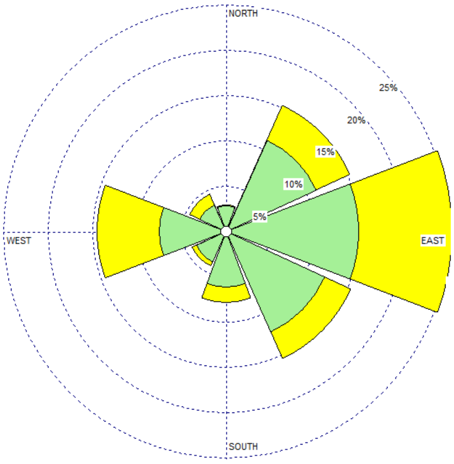


Figure 5-2: Wind Rose Plots – BOM Mangrove Mountain AWS ID 061375 – 2019 – Evening time

All Seasons

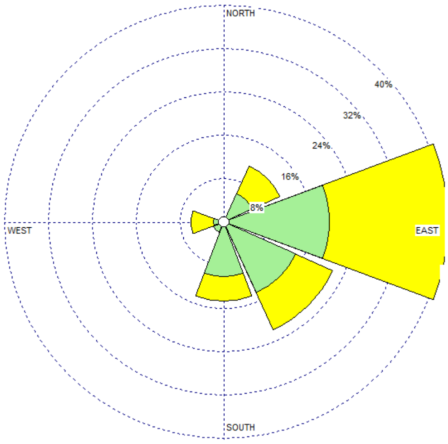


Average Wind Speed: 2.15 m/s

Calms Frequency: 9.40%

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

Summer Season (December – February)

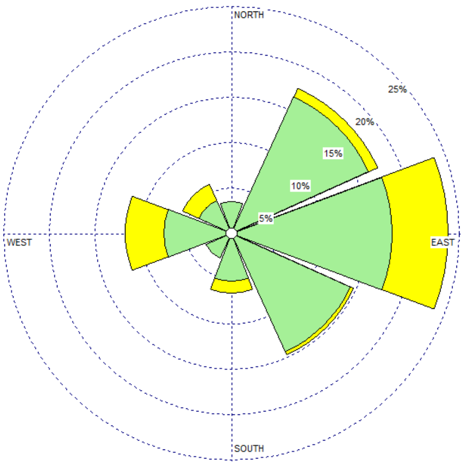


Average Wind Speed: 2.80 m/s

Calms Frequency: 1.73%

Axis Frequencies: 8%, 16%, 24%, 32%, 40%

Autumn Season (March – May)

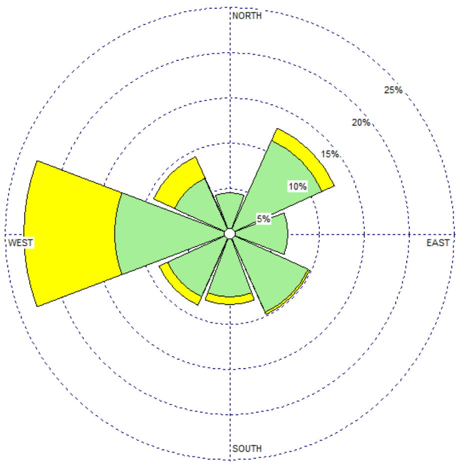


Average Wind Speed: 1.75 m/s

Calms Frequency: 9.87%

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

Winter Season (June – August)

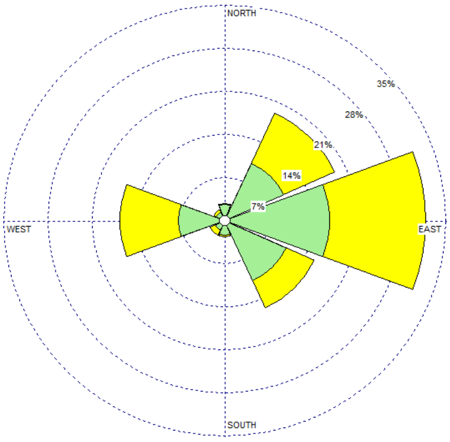


Average Wind Speed: 1.57 m/s

Calms Frequency: 13.02%

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

Spring Season (September – November)	Legend



Average Wind Speed: 2.56 m/s

Calms Frequency: 5.06%

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

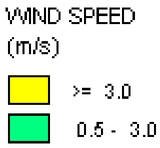
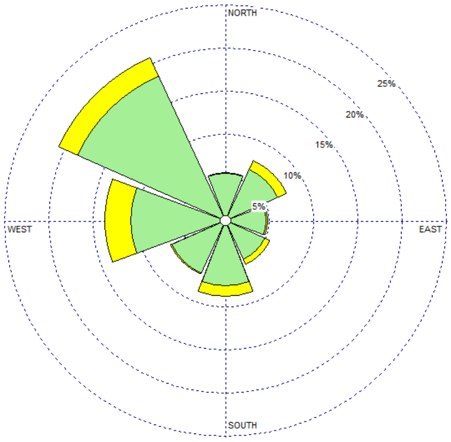


Figure 5-3: Wind Rose Plots – BOM Mangrove Mountain AWS ID 061375 – 2019 – Night time

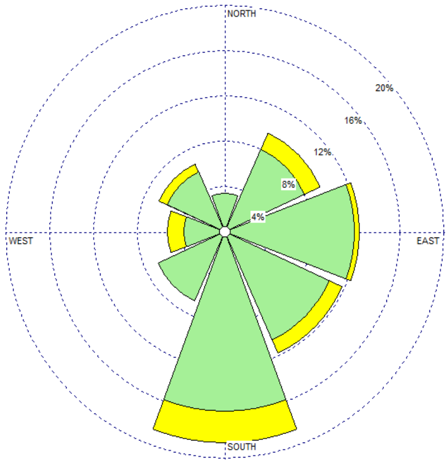
All Seasons	Summer Season (December – February)



Average Wind Speed: 1.20 m/s

Calms Frequency: 25.39%

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

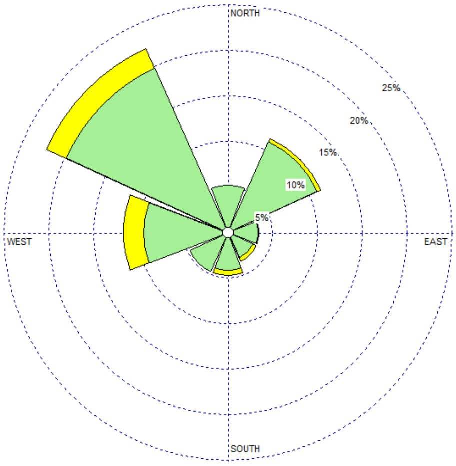


Average Wind Speed: 1.27 m/s

Calms Frequency: 21.90%

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

Autumn Season (March – May)

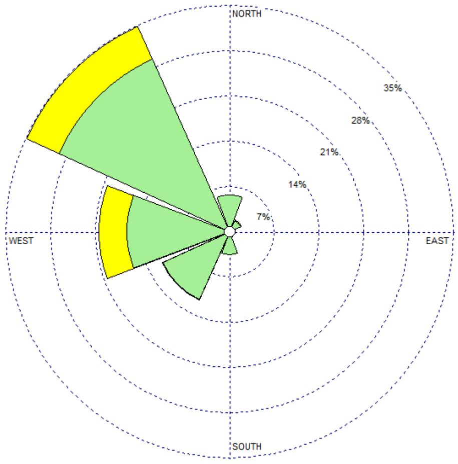


Average Wind Speed: 1.01 m/s

Calms Frequency: 28.27%

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

Winter Season (June – August)

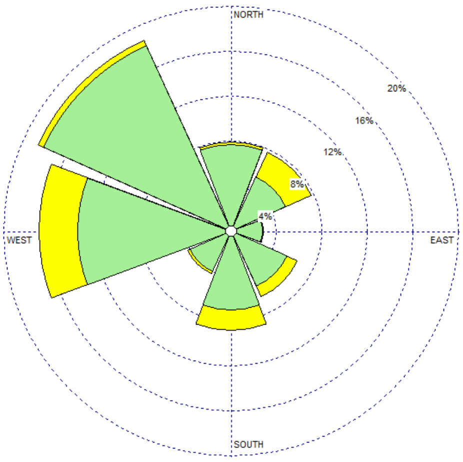


Average Wind Speed: 1.29 m/s

Calms Frequency: 17.21%

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

Spring Season (September – November)

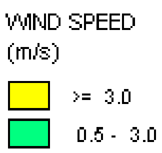


Average Wind Speed: 1.23 m/s

Calms Frequency: 1.23%

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 multiple instances where during a period/season, more than 30% of wind speeds are less than 3 m/s in the plus and minus 45 degree arc from source to receiver. However, only two instances occur during the daytime period when the site will operate. Only the two receivers affected in the daytime period (I6 and I12) will be considered in this scenario.

Therefore, wind effects have been included in the assessment for these two receivers.

Table 5-1: Noise Wind Component Analysis 2019 Mangrove Mountain AWS

Receiver	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
R1	7.0	16.3	27.6	13.1	6.4	10.6	21.5	11.5	11.6	12.6	25.0	17.1
R2	21.5	18.6	7	19.4	36.7	36.4	16.6	34.1	16.9	8	0.8	5.1
R3	18.4	16.1	4.2	16.2	26.7	32.3	17.4	27.5	16	12.4	2.4	7.2
R4	22.7	22.2	11.6	17.1	33.6	20.1	14.7	19.5	22.6	4.5	1.9	10.4
I5	12.6	13.9	8.4	8.8	21.9	10.1	9.5	9.6	17.7	3.6	1.6	8.8
I6	8.1	16.6	30.4	16	5.3	11.1	25.3	11.3	9.9	18.5	32.2	21
I7	14	18.4	21.7	12	18.6	9.2	16.3	6	23.8	8.1	14.3	12.8
I8	14.9	18.9	22.1	12.1	19.2	9	15.8	5.8	25.8	8	13.3	13.1
I9	14.9	19.1	21.8	12.4	19.7	9	15.5	5.5	26.2	8.2	13.2	12.8
I10	14.7	19.2	21.4	12.3	20	8.7	16	5.8	26.3	8.2	12.6	13.2
I11	14.8	19.1	21.8	12.4	19.7	9	15.5	5.5	26.2	8.2	13.2	12.8
I12	16.1	23.8	33.3	21	1.1	10.3	19.3	8.5	12	31.4	46.1	33.8
I13	23.7	21.8	8.4	19.8	37.5	24.7	14.1	25.3	19.4	3.4	1.3	8.2
I14	20	19.1	5.4	16.7	28.9	34.2	16.6	31	16.9	11.5	1.6	5.5
I15	15.1	19.1	21.9	12.4	19.7	9	15.5	5.5	26.2	8.2	13.2	12.8
I16	13.0	15.9	10.4	13.8	3.3	11.7	13	11.8	10.7	18.1	17.9	20.1
I17	23.3	22.4	8.4	19.5	36.9	24.5	14.1	24.5	19.1	3.5	1.3	8.3
I18	13.9	15.4	8.9	10.7	25.8	13.6	11.1	11.3	18.8	4.1	1.7	9.5
I19	14	18.5	21.6	12.0	18.6	9.2	16.3	6.0	23.8	8.1	14.3	12.9

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). As the site will not operate at night, temperature inversion is not considered.

5.2.1 Weather Conditions Considered in the Assessment

The following conditions were considered:

- Condition A: Neutral Weather Conditions
- Condition B: 3 m/s Wind from source to receiver (at I6, I12)

The meteorological condition considered in the noise model has been displayed in detail in Table 5-2.

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

Condition	Classification	Ambient Temp.	Ambient Humidity	Wind Speed	Wind Direction (blowing from)	Temperature Inversion	Affected Receptors	Applicability
A	Neutral	10°C	70%	–	–	No	All	Daytime
B	Wind	10 °C	70%	3 m/s	From Source to Receiver	No	I6, I12	Daytime

6. CURRENT LEGISLATION AND GUIDELINES

6.1 NSW EPA Noise Policy for Industry

6.1.1 Introduction

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

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

6.1.2 Project Intrusiveness Noise Level

The project intrusiveness noise level is determined as follows:

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

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

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

6.1.3 Amenity Noise Level

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW Noise Policy for Industry 2017. The relevant recommended noise levels applicable from the Noise Policy for Industry are reproduced in Table 6-1. The urban category has been selected for the residential noise amenity criteria to match the characteristics of the area.

Table 6-1: Relevant amenity noise levels.

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

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.

6.1.4 Sleep Disturbance Criteria

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

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

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

a detailed maximum noise level assessment should be undertaken.

6.1.5 Project Noise Trigger Levels

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

The table below presents the rating background level, project intrusive noise level, recommended amenity noise level, and project amenity noise level. The project noise trigger level is the lowest value of intrusiveness or project amenity noise level after conversion to $L_{Aeq\ 15\ minute}$, dB(A) equivalent level. Sleep disturbance trigger levels associated with operational activities are presented in Table 6-2.

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

Table 6-2: Project Noise Trigger Levels (PNTL) for Operational Activities, dB(A)

Receiver	Type of Receptor	Time of day	Rating background noise level	Project intrusiveness noise level $L_{eq\ 15\ minute}$	Recommended amenity noise level $L_{Aeq\ period}$	Project amenity noise level $L_{Aeq\ 15\ minute}$ [1]	PNTL $L_{Aeq\ 15\ minute}$	Sleep Disturbance L_{Amax}
R1	Residential – Rural	Day	42	**47**	50	48	**47**	**-**
		Evening	41	46	45	**43**	**43**	**-**
		Night	35	40	40	**38**	**38**	**52**
R2-R4, R13, R14	Residential – Rural	Day	35	**40**	50	48	**40**	**-**
		Evening	35[2]	**40**	45	43	**40**	**-**
		Night	34	39	40	**38**	**38**	**52**
I5-I12, I15-I19	Industrial Premises	When in use	-	-	70	68	**68**	**-**

Notes:

1) These levels have been converted to $L_{Aeq\ 15\ minute}$ using the following: $L_{Aeq\ 15\ minute} = L_{Aeq\ period}$ - 2 dB (NSW Noise Policy for Industry Section 2.2).
2) The project intrusiveness noise level for evening be set at no greater than the project intrusiveness noise level for daytime (NSW Noise Policy for Industry Section 2.3).

6.1.5.1 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).

Further details to assess annoying characteristics are described in Fact Sheet C of the Noise Policy for Industry, summarised below.

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

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

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

Factor	Assessment / measurement	When to apply	Correction[1]	Comments
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-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: • Were any of the one-third octave noise levels in Table C2 exceeded by up to and including 5 dB(A) and cannot be mitigated? A 2-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • Were any of the one-third octave noise levels in Table C2 exceeded by more than 5 dB(A) 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.

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

Factor	Assessment / measurement	When to apply	Correction[1]	Comments
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for **night-time only**.
Duration	Single-event noise duration may range from 1.5 min to 2.5 h.	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum adjustment	Refer to individual modifying factors.	Where two or more modifying factors are indicated.	Maximum correction of 10 dB(A)[2] (excluding duration correction).	

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

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

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

6.2 NSW Road Noise Policy

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

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

6.2.1 Road Category

The subject site is accessed via Somersby Falls Road. This is classified as a local road in accordance with the RNP descriptions.

6.2.2 Noise Assessment Criteria

Section 2.3 of the RNP outlines the criteria for assessing road traffic noise. The relevant sections of Table 3 of the RNP are shown in Table 6-4.

Table 6-4: Road Traffic Noise Assessment Criteria For Residential Land Uses, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)*	
		Day (7am-10pm)	Night (10pm-7am)
Local Roads	6. Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 dB	$L_{Aeq\ (1\ hour)}$ 50 dB

* Measured at 1 m from a building façade.

6.2.3 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.

6.2.4 Exceedance of Criteria

If the criteria shown in Table 6-4 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’.

6.2.5 Assessment Locations for Existing Land Uses

Table 6-5: 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.
Commercial or industrial premises	The noise level is to be assessed at the reasonably most affected point or within the property boundary. This requirement should not be read to infer that the noise level only applies at the 'reasonably worst-affected location'.

6.3 CONSTRUCTION NOISE CRITERIA

Criteria for construction and demolition noise has been obtained from the NSW Interim Construction Noise Guideline (DECC, 2009). Guidance for construction vibration has been taken from British Standard BS7385-Part 2: 1993 '*Evaluation and measurement for vibration in buildings*' and other standards.

6.3.1 NSW Interim Construction Noise Guideline

Residential Criteria

Table 2 of the Interim Construction Noise Guideline (DECC, 2009), sets out construction noise management levels for noise at residences and how they are to be applied. The management noise levels are reproduced in Table 6-6 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 6-6: Management Levels at Residences Using Quantitative Assessment

<table>
<tr><th>Time of Day</th><th>Management Level $L_{Aeq(15 \text{ minute})}$</th><th>How to Apply</th></tr>
<tr><td rowspan="2">Recommended standard hours:

Monday to Friday
7am – 6pm

Saturday
8am – 1pm

No work on Sundays or Public Holidays</td><td>Noise Affected
RBL + 10 dB</td><td>The noise affected level represents the point above which there may be some community reaction to noise.

• Where the predicted or measured $L_{Aeq(15 \text{ minute})}$ 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.</td></tr>
<tr><td>Highly Noise Affected
75 dB(A)</td><td>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.</td></tr>
</table>

Table 6-6: Management Levels at Residences Using Quantitative Assessment

Time of Day	Management Level $L_{Aeq(15\ minute)}$	How to Apply
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 6-7 sets out management levels for construction noise at other land uses applicable to the surrounding area.

Table 6-7: 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)
School Classrooms[1]	External Noise Level 55 dB(A)
Place of Worship	External Noise Level 55 dB(A)

Note: [1] As per Section 4.1.2 of the Interim Construction Noise Guideline, a conservative estimate of 10 dB difference between internal and external levels is applied.

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

Noise Criterion

The noise criterion for construction noise is presented in Table 6-8.

Table 6-8: 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
R2, R4, R14, R15	Residential	Standard Hours	35	45

I5-I12, I15-I19	Industrial	During Use	-	75

6.3.2 Vibration Criteria

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

6.3.3 BS 7385-2:1993

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

Table 6-9: Vibration criteria for cosmetic damage (BS 7385:2 1993)

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

6.3.4 DIN4150-3:1999

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

Table 6-10: Structural damage criteria heritage structures (DIN4150-3 1999)

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

6.3.5 Human Exposure

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

Table 6-11: 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

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. This assessment considers existing and proposed noise sources operating simultaneously in accordance with the Noise Policy for Industry requirements.

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 proposed developments, and is recognised by regulatory authorities throughout Australia. The model allows for the prediction of noise from a site at the specified receptor, by calculating the contribution of each noise source. Other model inputs included the noise sources, topographical features of the subject area, surrounding buildings, noise walls and receiver locations.

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

7.1.1 Noise Sources

The sound power levels for the identified noise sources associated with the operational activities have been taken from Benbow Environmental's database.

A-weighted third octave band centre frequency sound power levels have been used and are presented in Table 7-1 below. The noise sources utilised as part of this assessment comprise of the primary noise generating activities associated with the effective operation of the proposed development.

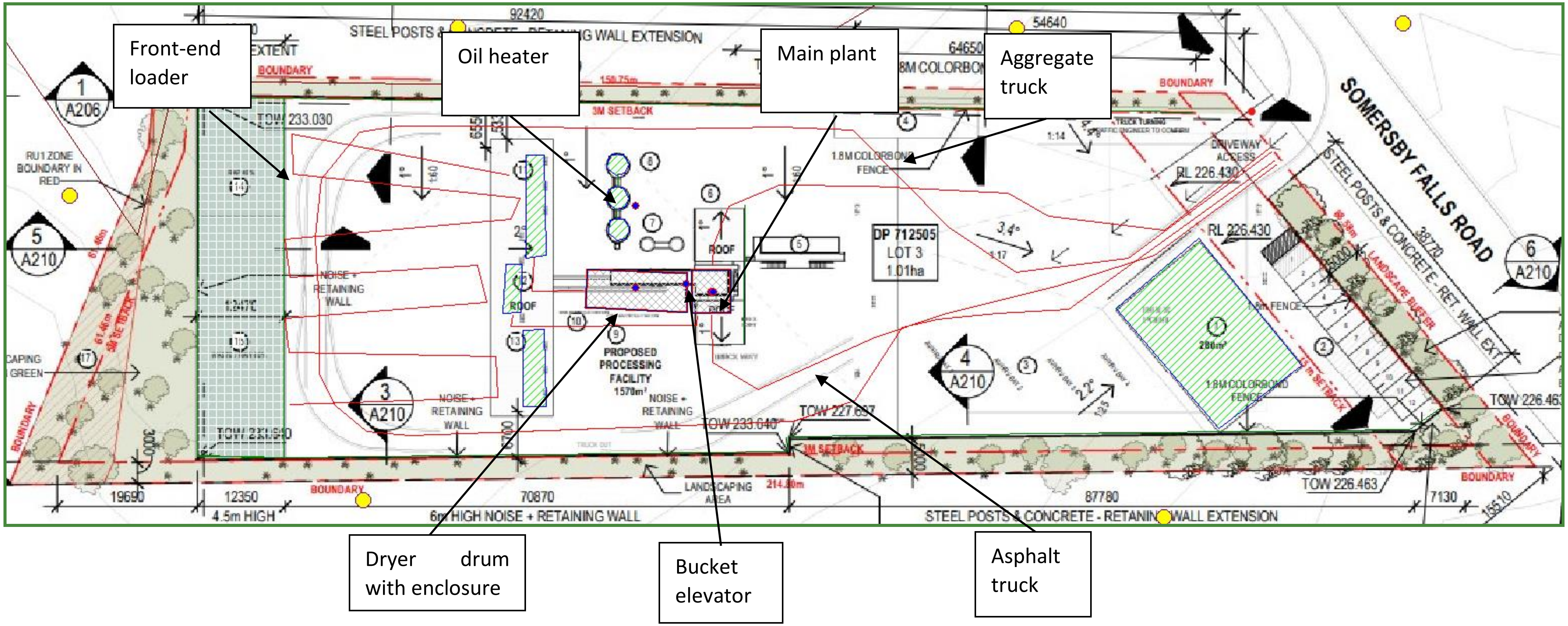
Table 7-1: A-weighted Sound Power Levels Associated with Operational Activities, dB(A)

Noise Source	L_{Amax}	Overall $L_{Aeq(15\ minute)}$	Height	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
FEL	110	101	1 m	48	58	71	72	79	77	75	80	82	85
				92	87	90	92	90	91	90	90	89	89
				88	84	82	80	77	74	70	66	61	56
Aggregate Hopper	110	106	5 m	-	65	-	-	72	-	-	77	-	-
				84	-	-	91	-	-	95	-	-	98
				-	-	100	-	-	102	-	-	95	-
Conveyor	88	78	2 m	27	30	28	34	37	47	44	47	52	56
				56	63	66	69	67	70	69	71	70	69
				62	61	57	55	51	47	43	41	34	27
Dryer Drum	-	113	3 m	-	-	67	69	71	74	78	85	93	91
				93	97	104	103	102	102	99	100	102	102
				102	100	100	99	98	94	90	-	-	-
Oil Heater	103	91	1 m	-	-	53	63	65	63	67	73	74	73
				74	74	76	78	79	79	80	80	80	80
				80	79	79	77	75	72	69	-	-	-
Bucket Elevator	97	86	9 m	-	-	48	55	52	52	55	61	61	62
				62	67	66	68	70	69	70	71	73	77
				79	77	76	74	73	71	68	-	-	-
Screen	-	102	15 m	42	57	58	66	71	78	75	80	84	85
				84	89	95	93	90	91	91	90	90	90
				89	88	85	83	80	77	74	69	62	54
Pugmil	-	97	8 m	-	-	55	59	60	65	66	69	72	74
				74	80	75	83	84	87	84	86	90	92
				86	84	82	80	79	77	74	-	-	-
Truck Exhaust	103	101	3 m	42	46	55	63	68	71	76	76	78	80
				81	83	92	96	92	94	87	86	80	85
				83	82	80	81	81	80	76	-	-	-
Truck Engine	106	103	1.5 m	44	48	57	65	70	73	78	78	80	82
				83	85	94	98	94	96	89	88	82	87
				85	84	82	83	83	82	78	-	-	-

7.1.2 Modelling Scenarios

One scenario have been modelled. Scenario 1 includes all sources operating occurring only during the day. Scenario 1 has been modelled under neutral and noise enhancing wind conditions. Figure 7-1 shows the locations of the noise sources for the operational scenario.

Figure 7-1: Scenario 1 Source Locations



7.1.3 Modelling Assumptions

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

- Topographical information of the surrounding area has been obtained from Sixmaps and implemented in SoundPLAN. Topographical information of the site has been obtained from the most recent architectural plans and implemented in SoundPLAN.

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

- Surrounding buildings have been included in the noise model.

- 2 trucks are assumed to enter and leave the site every 15 minutes in a worst-case scenario. Trucks have been assumed to travel on the site at 10 km/h. Trucks are modelled in sound plan as line sources, utilising moving point source definition. They occur during all time periods.

- The dryer and main stack enclosure have been modelled with noise controls as presented in Figure 7-1.

- All point sources are modelled operating 100% of the time, except for the hopper loading which are modelled with a time histogram of 2 minutes/hour.

- All residential receivers were modelled at 1.5 m above ground level at the most noise-affected point within the property boundary 30 m from the dwelling.

- Wall configurations and heights have been obtained from the most recent architectural plans and implemented within SoundPLAN.

7.2 PREDICTED NOISE LEVELS – OPERATIONAL

Noise levels at the nearest receptors have been calculated and results of the predictive noise modelling considering operational activities are shown in Table 7-2. The modelled scenarios are predicted to comply with the $L_{Aeq(15\ minute)}$ and L_{AMax} project specific criteria at all sensitive receptors.

Noise controls are outlined in Section 7.4.

Table 7-2: Predicted Noise Levels – Operational Activities dB(A)

Receptor	Project Criteria $L_{eq(15\ minute)}$			Scenario 1A – Day All Equipment	Scenario 1B – Day All Equipment (noise enhancing wind conditions)[1]
	Day	Evening	Night	Predicted $L_{eq(15\ minute)}$	Predicted $L_{eq(15\ minute)}$
R1	47	43	38	45✓	-
R2	40	40	38	29✓	-
R3	40	40	38	36✓	-
R4	40	40	38	31✓	-
I5	68			46✓	
I6	68			39✓	41✓
I7	68			50✓	-
I8	68			47✓	-
I9	68			45✓	-
I10	68			435✓	-
I11	68			40✓	-
I12	68			36✓	39✓
R13	40	40	38	34✓	-
R14	40	40	38	23✓	-
I15	68			43✓	-
I16	68			46✓	-
I17	68			47✓	-
I18	68			65✓	-
I19	68			58✓	-

✓Complies × Non-compliance

1. As mentioned in Section 5.1.2 and 5.2.1, only I6 and I12 experienced more than 30% of wind speeds less than 3 m/s in the plus and minus 45 degree arc from source to receiver during the daytime. Therefore, they are the only receivers considered in Scenario 1B.

7.3 Assessment of Annoying Characteristics

7.3.1 Tonal noise

One-third octave levels at residential receptors were assessed for tonal impacts. However, no tonal component in accordance with the Noise Policy for Industry 2017 was calculated.

7.3.2 Low Frequency Noise

Low frequency noise for the proposed scenario described in this section, has been evaluated as part of this assessment. This is described in Section 6.1.5.1.

Table 7-3: Low Frequency Calculation

Receiver	C-Weighted Level	A-Weighted Level	Difference	Further Assessment Applies?
R1	56	46	10	No

Receiver	C-Weighted Level	A-Weighted Level	Difference	Further Assessment Applies?
R2	44	29	15	Yes
R3	51	38	13	No
R4	45	35	10	No
I5	56	49	7	No
I6	51	39	12	No
I7	58	51	7	No
I8	46	49	7	No
I9	55	47	8	No
I10	53	45	8	No
I11	49	42	7	No
I12	50	38	12	No
R13	47	34	13	No
R14	41	25	16	Yes
I15	52	45	7	No
I16	61	55	6	No
I17	59	45	14	No
I18	71	64	7	No
I19	66	59	7	No

As can be seen in the table above, two receivers (R2 and R14) experience a C and A-weighted difference of equal to or more than 15 dB. Therefore, further assessment against the threshold levels is required.

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
R2	1: Proposed	Predicted levels	30	36	40	38	37	35	26	28	32
		Exceedance	0	0	0	0	0	0	0	0	0
R14	1: Proposed	Predicted levels	27	34	36	35	34	32	22	25	27
		Exceedance	0	0	0	0	0	0	0	0	0

There are no exceedances within the low frequency bands and a 2dB penalty during the daytime only applies for an exceedance of 6 dB or more above the threshold levels. Therefore, no low frequency penalty applies.

7.3.3 Intermittent Noise

No noise sources associated with the existing nor proposed operations are likely to generate intermittent characteristics. No noise sources heard at the receiver varies by more than 5 dB(A) (the max levels are not above 5 dB(A) of the L_{Aeq}) and no intermittent nature is audible. Further assessment is not warranted.

The following table addresses annoying noise as per fact sheet C of the noise policy for industry.

Table 7-5: Annoying Noise Characteristics

Factor	Comment	Applies
Tonal Noise	Z – Weighted 1/3 octave were assessed for tonal impacts. No tonal noise associated with the site was found.	No
Low-Frequency Noise	The difference between predicted C-weighted levels and predicted A-weighted levels are more than 15 dB at two receptors, therefore low frequency impacts apply.	No
Intermittent noise	No noise sources operate at night.	No

7.4 RECOMMENDED MITIGATION MEASURES

- The height of the walls of the raw materials/RAP bunker in the rear of the site shall be a minimum of 4.5 m high and constructed in concrete tilt up panels. This structure connects to the walls inside the northern and southern boundaries and shall be 6 m high on the southern end to connect with the proposed 6 m high acoustic wall.

- 6 m high acoustic wall (height measured from the floor of the plant) setback 3 m inside the southern boundary along the length of the hopper loading area and main plant. This wall should be constructed in concrete tilt up panels.

- 1.8 m high acoustic wall along the northern boundary. The 1.8 m high wall along the northern boundary is measured from the floor level of the plant hardstand. When the proposed retaining wall is greater than 1.8 m no wall is required as the retaining wall satisfies the height requirements. Where the retaining wall is less than 1.8 m high the acoustic wall should sit on top of the proposed retaining wall such that the total height measured from the plant hardstand is 1.8 m or greater. This will be made from 0.42 base metal thickness (BMT) Colorbond.

- 1.8 m high acoustic wall should be located on top of the retaining wall that is setback 5 m from the south-eastern boundary. This wall should be made from 0.42 BMT Colorbond.

- 8 m high Besser block wall to be in front of the truck loading area.

- 8 m high Besser block wall in front of the hoppers.

- Bitumen tanks are 11.5 m high and connected with an 11.5 m high wall in-between. The wall is to be made of 0.42 BMT Colorbond.

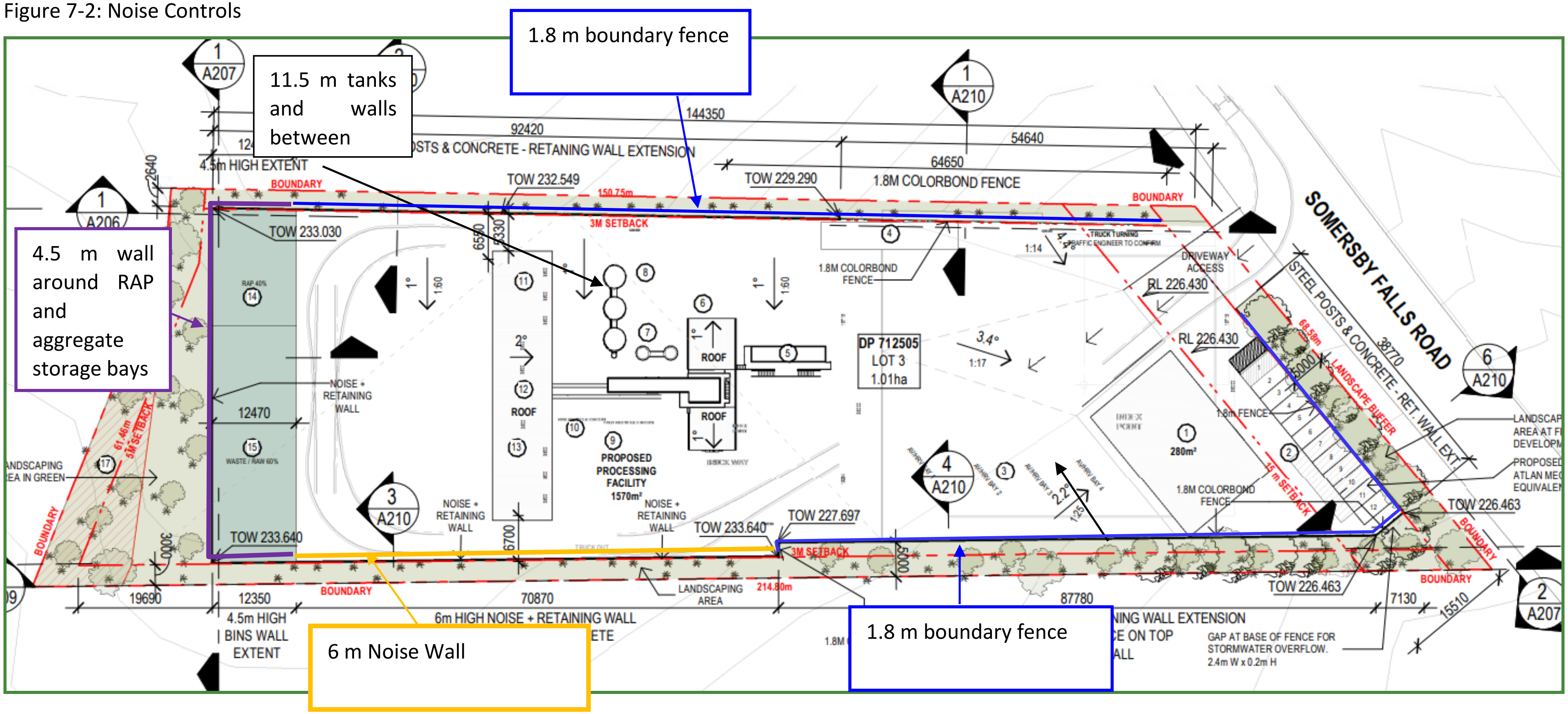
- Drum burner must be enclosed – Building $R_w \geq 27$ (0.42 BMT on all facades). The building is proposed to be made from Colorbond steel with a base metal thickness (BMT) of 0.42.

- The main stack processing plant must be enclosed – Building $R_w \geq 27$ (0.8 BMT) for the walls, 0.42 for the roof. The walls are proposed to be made from Colorbond steel with a BMT of 0.8, while the roof is to be made from Colorbond steel with a BMT of 0.42.

- The asphalt loading area underneath the batching plant must be enclosed to house the truck loading. Acoustic curtains are to be installed. General industrial acoustic curtains typically consist of a flexible panel incorporating a series of acoustic materials, such as mineral wool or fiberglass insulation, encased within a waterproof and durable tarpaulin casing. The specific materials and supplier details for the acoustic curtains will be verified prior to installation by a qualified acoustic consultant to ensure compliance.

The facility must build the facility with these controls as specified in order to sufficiently reduce the noise levels. The following figure displays the controls.

Figure 7-2: Noise Controls



8. ROAD TRAFFIC NOISE IMPACT ASSESSMENT

Truck movements are modelled moving south along Somersby Falls Road passing the residential receiver R1. The maximum number of truck movements along Somersby Falls Road is assumed to be 8 trucks per hour associated with the proposed asphalt plant. Trucks have been modelled passing this house as 2 moving line sources (engine and exhaust) using sound power levels as shown in operational noise source table traveling at 50km/hr.

Table 8-1: Predicted Levels for Road Traffic Noise

Receptor	Noise Criteria		Site Contribution		Existing Road Traffic Noise		Total Road Traffic Noise	
	Day $L_{Aeq,\,1\,hour}$	Night $L_{Aeq,\,1\,hour}$	Day $L_{Aeq,\,1\,hour}$	Night $L_{Aeq,\,1\,hour}$	Day $L_{Aeq,\,1\,hour}$	Night $L_{Aeq,\,1\,hour}$	Day $L_{Aeq,\,1\,hour}$	Night $L_{Aeq,\,1\,hour}$
R1	55	50	46	46	55	49	56	51

Although this exceeds the residential criteria, based on consultation with the neighbour, as R1 is looking to be re-zoned to industrial, the exceedance will not be of concern. The predicted levels also do not exceed the relative increase criteria of 2dB(A).

Step 3 of Section 3.4.1 of the RNP identifies possible reasonable and feasible control measures when exceedances of either outlined criteria.

9. CONSTRUCTION NOISE IMPACT MANAGEMENT

9.1 Modelled Noise Generating Scenarios

Two 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:

- Excavation and earthworks (scenario 1); and
- Concreting works (scenario 2);

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, with an equipment location diagrams in Figure 9-1 and Figure 9-2.

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. Excavation and Regrading works	Standard hours	• 20T Excavator • Backhoe • Truck • Hand Tools
2. Concreting construction works	Standard hours	• Concrete mixer truck • Concrete pump • Hand tools

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

Figure 9-1: Construction Scenario 1 – Excavation and Regrading Works

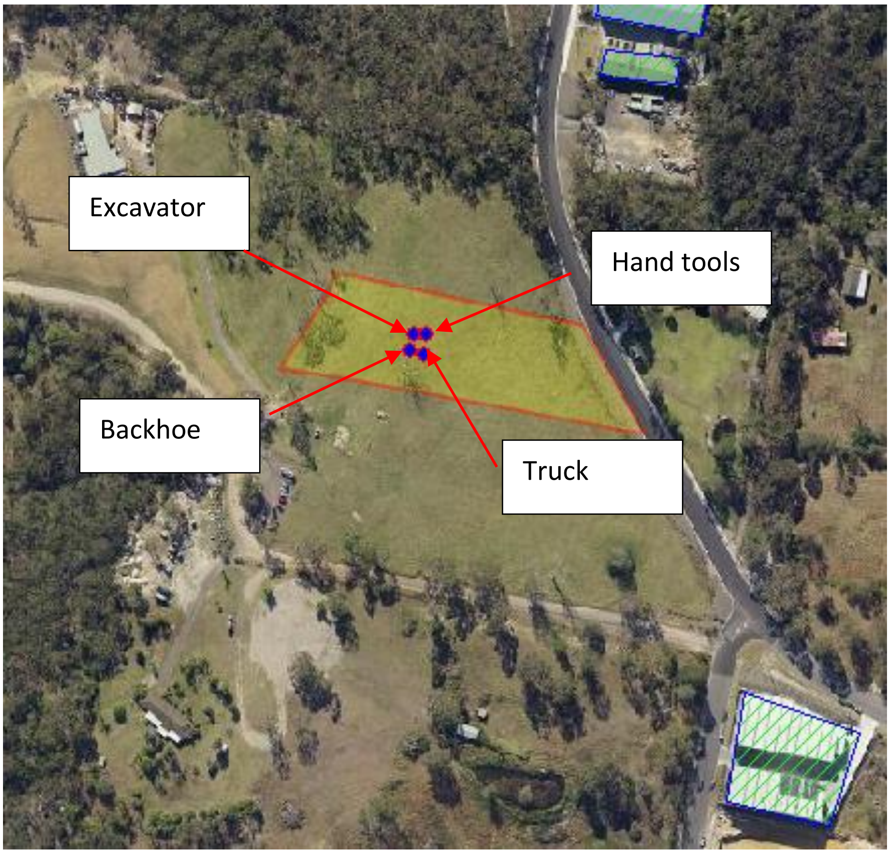


Figure 9-2: Construction Scenario 2 – Concreting Construction Works

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
Excavator 20T	**110**	103	101	100	101	102	102	97	90
Truck	**106**	76	84	89	104	95	93	88	88
Hand tools	**100**	71	81	91	96	94	90	87	81
Backhoe	**104**	102	94	92	92	91	88	87	78
Concrete truck	**108**	85	86	85	94	98	107	89	82
Concrete pump truck	**105**	77	92	97	99	100	95	95	89

9.3 Construction Predicted Noise Levels

Results of the predictive noise modelling of the construction activities are shown in

Table 9-3.

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

Receiver	PSNL ($L_{eq,15\ minute}$ dB(A)) Standard Hours	Scenario (Standard Hours) (L_{eq}, dB(A))	
		1	2
R1	52	58×	59×
R2	45	36✓	39✓
R3	52	48✓	51✓
R4	45	44✓	45✓
I5	75	52✓	54✓
I6	75	50✓	53✓
I7	75	54✓	56✓
I8	75	52✓	54✓
I9	75	51✓	54✓
I10	75	48✓	50✓
I11	75	46✓	47✓
I12	75	46✓	49✓
R13	45	46×	49×
R14	45	35✓	38✓
I15	75	48✓	51✓
I16	75	60✓	62✓
I17	75	63✓	65✓
I18	75	62✓	64✓

✓Complies × Non-compliance

It can be seen that the predicted noise levels associated with construction exceed the noise management level at R1 and R13. The construction noise scenario represents a worst case scenario that may not occur in practice, and expected impacts on the surrounding receivers are predicted to be lower than the results presented in Table 9-3. None of the predicted noise levels exceed the highly noise affected management level of 75 dB(A).

9.3.1 Construction Noise Mitigation Measures

As per the guidance from the NSW Interim Construction Noise Guidelines, the proponent should consider notifying the nearby receivers where applicable via letter box drops of the proposed construction works:

> *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.*

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

Monday to Friday:	7am to 6pm
Saturday:	8am to 1pm
Sunday and Public Holidays:	No works permitted

Using Chapter 6 of the Interim Construction Noise Guideline, some reasonable and feasible work practises and mitigation measures that could be considered for adoption are as follows:

- Construct the boundary walls before commencing other construction operations;
- Where possible stagger the use of noisy equipment (front end loader, grinder, welder etc.) such that they do not operate simultaneously;
- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- Regular identification of noisy activities and adoption of improvement techniques;
- Avoiding the use of portable radios, public address systems or other methods of site Communication that may unnecessarily impact upon nearby residents;
- Where possible, avoiding the use of equipment that generates impulsive noise;
- Minimising the need for vehicle reversing for example, by arranging for one-way site traffic routes;
- Use of broadband audible reverse alarms on vehicles and elevating work platforms used on site;
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact;
- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- Regularly inspecting and maintaining plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively;
- Locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or
- Orientating the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise;
- Minimising truck movements; and
- Scheduling respite periods for intensive works.

Adopting these work practices will significantly reduce the impact of the construction works at the nearest sensitive receivers.

10. VIBRATION IMPACT ASSESSMENT

In the Transport for NSW 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. The construction work proposed would not use this type of equipment and is not expected to cause vibration impacts. The equipment utilised for the asphalt batching plant will not generate vibration impacts therefore a detailed Vibration Impact Assessment is therefore not considered warranted.

11. STATEMENT OF POTENTIAL NOISE IMPACT

Benbow Environmental has been engaged by Stateline Asphalt Pty Ltd to prepare a Noise and Vibration Impact Assessment for an asphalt batching plant at 133 Somersby Falls Road, Somersby NSW 2250 (Lot 2 DP712505 This report has been completed as part of an Environmental Impact Statement (EIS) for the proposed development. It was prepared after the issue of the Secretary's environmental assessment requirements (SEARs) number 1655.

The proposed development includes installation of an asphalt mixing plant with a capacity to produce approximately 200 tonnes of asphalt per hour would generate up to 200,000 tonnes of new asphalt material per annum. This noise report assesses contributions from the proposed asphalt plant operations.

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

Operational noise is predicted to comply with the Noise Policy for Industry (2017) criteria at all residential receptors with the noise controls presented in Section 7.4.

The predicted noise levels associated with construction exceed the noise management level at residential receiver R1 and R13, compliance is achieved at all other receivers. None of the predicted noise levels exceed the highly noise affected management level of 75 dB(A). Standard construction hours and universal work practices are recommended.

The site is predicted to comply with the Road Noise Policy.

Vibration impacts from the proposed asphalt batching plant are considered negligible.

Prasanna Manoharan	Bethany Carlyon	R T Benbow
Chemical Engineer	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
Stateline Asphalt Pty Ltd , as per our agreement for providing environmental services. Only
Stateline Asphalt Pty Ltd is entitled to rely upon the findings in the report within the scope of work described in this report. Otherwise, no responsibility is accepted for the use of any part of the report by another in any other context or for any other purpose.

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

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

ATTACHMENTS

Attachment 1: Noise Terminology

‘A’ FREQUENCY WEIGHTING

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

AMBIENT NOISE

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

AUDIBLE

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

BACKGROUND NOISE LEVEL

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

‘C’ FREQUENCY WEIGHTING

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

DECIBEL

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

dBA – See 'A' frequency weighting

dBC – See 'C' frequency weighting

EQUIVALENT CONTINUOUS SOUND LEVEL, LAeq

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

'F'(FAST) TIME WEIGHTING

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

FLETCHER–MUNSON EQUAL LOUDNESS CONTOUR CURVES

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

FREE FIELD

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

FREQUENCY

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

IMPACT ISOLATION CLASS (IIC)

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

'I' (IMPULSE) TIME WEIGHTING

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

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

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

IMPULSE NOISE

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

LOUDNESS

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

MAXIMUM NOISE LEVEL, LAFmax

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

MAXIMUM NOISE LEVEL, LASmax

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

NOISE RATING NUMBERS

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

NOISE

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

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient"

OFFENSIVE NOISE

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

PINK NOISE

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

REVERBERATION TIME, T60

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

SOUND ABSORPTION COEFFICIENT, α

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

'S' (SLOW) TIME WEIGHTING

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

SOUND ATTENUATION

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

SOUND EXPOSURE LEVEL (LAE)

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

SOUND PRESSURE

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

SOUND PRESSURE LEVEL, Lp

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

SOUND POWER

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

SOUND POWER LEVEL, Lw

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

SOUND TRANSMISSION CLASS (STC)

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

SOUND TRANSMISSION LOSS

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

STATISTICAL NOISE LEVELS, Ln.

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

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

STEADY NOISE

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

WEIGHTED SOUND REDUCTION INDEX, Rw

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

WHITE NOISE

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

'Z' FREQUENCY WEIGHTING

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

Attachment 2: Calibration Certificates

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: SLM29941

EQUIPMENT TESTED: Sound & Vibration Analyser

Manufacturer:	Svantek		
Type No:	Svan-957	**Serial No:**	15336
Mic. Type:	7052E	**Serial No:**	47869
Pre-Amp. Type:	SV12L	**Serial No:**	18743
Filter Type:	1/3 Octave	**Test No:**	FILT 6546

Owner: Benbow Environmental
25-27 Sherwood Street
Northmead, NSW 2152

Tests Performed: IEC 61672-3:2013, IEC 1260:1995, & AS/NZS 4476:1997

Comments: All Test passed for Class 1. (See overleaf for details)

CONDITIONS OF TEST:

Ambient Pressure	1006	hPa ±1 hPa	**Date of Receipt :**	02/07/2021
Temperature	22	°C ±1° C	**Date of Calibration :**	05/07/2021
Relative Humidity	37	% ±5%	**Date of Issue :**	05/07/2021

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

CHECKED BY: .... **AUTHORISED SIGNATURE:** ....

Hein Soe

Accredited for compliance with ISO/IEC 17025 - Calibration

Results of the tests, calibration and/or measurements included in this document are traceable to SI units through reference equipment that has been calibrated by the Australian National Measurement Institute or other NATA accredited laboratories demonstrating traceability.

This report applies only to the item identified in the report and may not be reproduced in part.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

NATA
WORLD RECOGNISED ACCREDITATION

Acu-Vib Electronics
CALIBRATIONS SALES RENTALS REPAIRS

Accredited Lab No. 9262
Acoustic and Vibration Measurements

Head Office & Calibration Laboratory
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
(02) 9680 8133
www.acu-vib.com.au

Certificate Of Calibration

Certificate No: C35924

Equipment Tested : Sound Level Calibrator

Manufacturer: Rion
Type No: NC-73 **Serial No:** 10186522
Owner: Benbow Environmental
25-27 Sherwood Street
Northmead, NSW 2152
Tests Performed: Measured Output Pressure level, Frequency & Distortion
Comments: See Details overleaf. All Test Passed.

Parameter	Pre-Adj	Adj Y/N	Output: (dB re 20 µPa)	Frequency (Hz)	THD&N (%)
Level:	93.9	Y	94.02 dB	989.59 Hz	0.79 %
Uncertainty			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

Condition Of Test:

Ambient Pressure 999 hPa ±1 hPa
Temperature 23 °C ±1° C
Relative Humidity 52 % ±5%

Date of Receipt : 26/04/2023
Date of Calibration : 01/05/2023
Date of Issue : 01/05/2023

Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2017

Checked by: KB

Authorised Signature: Hein Soe

Accredited for compliance with ISO/IEC 17025 - Calibration
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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C22501

Client Details	Benbow Environmental Pty Ltd 25-27 Sherwood Street Northmead NSW 2152
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	87823C
Microphone Serial Number :	21753
Pre-amplifier Serial Number :	28663
Firmware Version :	12.6

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	23.9°C	**Ambient Temperature :**	24°C
Relative Humidity :	46.2%	**Relative Humidity :**	46.2%
Barometric Pressure :	100.56kPa	**Barometric Pressure :**	100.5kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Dhanush Bonu
Calibration Date :	27 Jul 2022	**Report Issue Date :**	28 Jul 2022

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*N/A*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.13dB*	*Temperature*	*±0.1°C*
1kHz	*±0.13dB*	*Relative Humidity*	*±1.9%*
8kHz	*±0.14dB*	*Barometric Pressure*	*±0.014kPa*
Electrical Tests	*±0.13dB*		

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

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

NATA
WORLD RECOGNISED ACCREDITATION

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

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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

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

Calibration Number C21453

Client Details Benbow Environmental
25-27 Sherwood Street
Northmead NSW 2152

Equipment Tested/ Model Number : ARL EL-215
Instrument Serial Number : 194552
Microphone Serial Number : N/A
Pre-amplifier Serial Number : N/A

Atmospheric Conditions
Ambient Temperature : 23.6°C
Relative Humidity : 39.9%
Barometric Pressure : 100.9kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 8 Jul 2021
Secondary Check: Rhys Gravelle
Report Issue Date : 8 Jul 2021

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	*±0.13dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.19dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.31dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.1dB*		

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

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

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

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

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

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

Attachment 3: QA/QC Procedures

Calibration of Sound Level Meters

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

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

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

Care and Maintenance of Sound Level Meters

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

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

Investigation Procedures

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

The following information was recorded and kept for reference purposes:

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

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

Unattended Noise Monitoring

NOISE MONITORING EQUIPMENT

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

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

METEOROLOGICAL CONSIDERATION DURING MONITORING

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

DESCRIPTORS & FILTERS USED FOR MONITORING

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

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

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

ATTENDED NOISE MONITORING

NOISE MONITORING EQUIPMENT

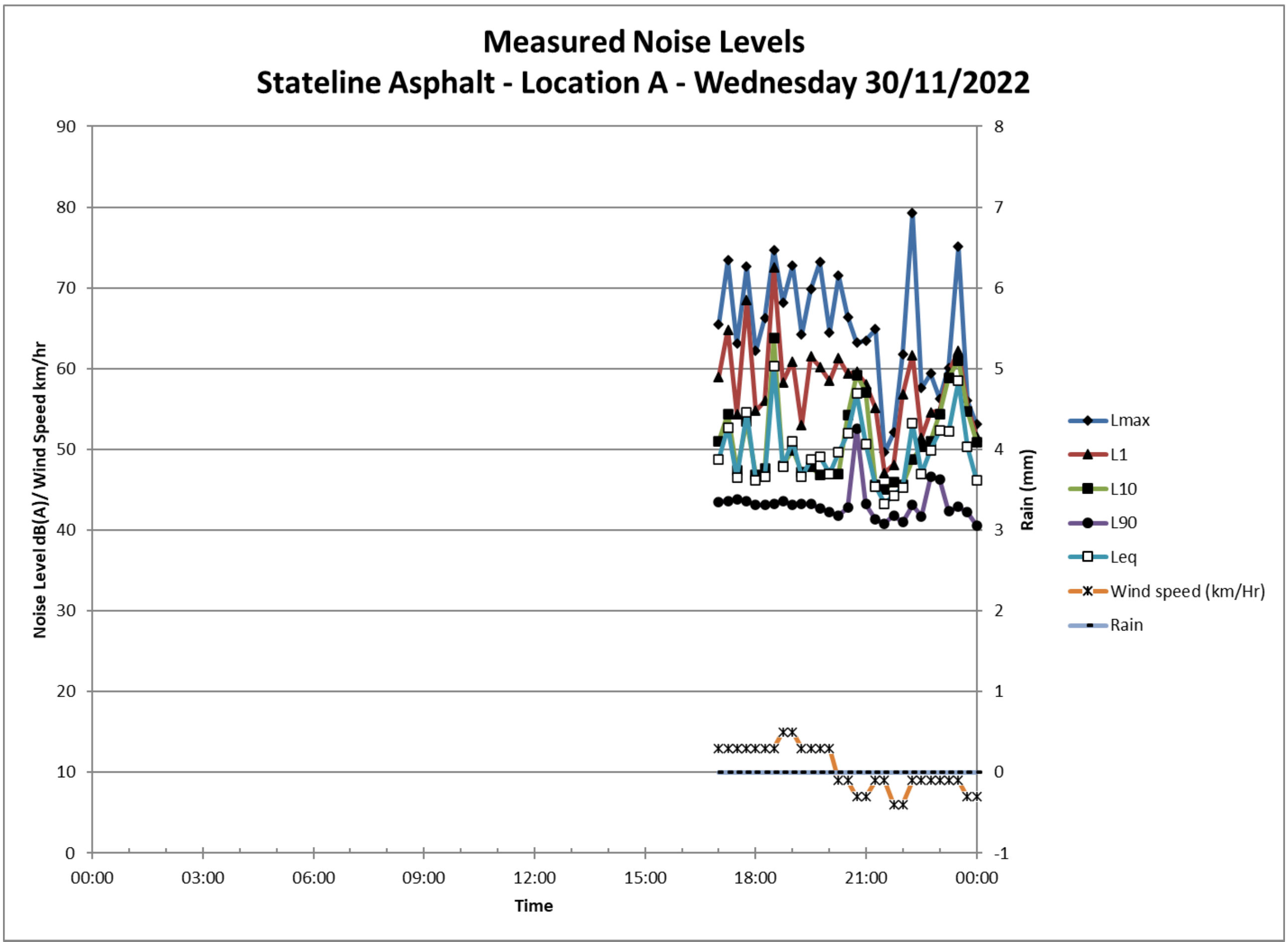
The attended short-term noise monitoring was carried out using a SVANTEK SVAN957 Class 1 Precision Sound Level Meter. The instrument was calibrated by a NATA accredited laboratory within two years of the measurement period. The instrument sets comply with AS 1259 and was set on A-weighted, fast response.

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

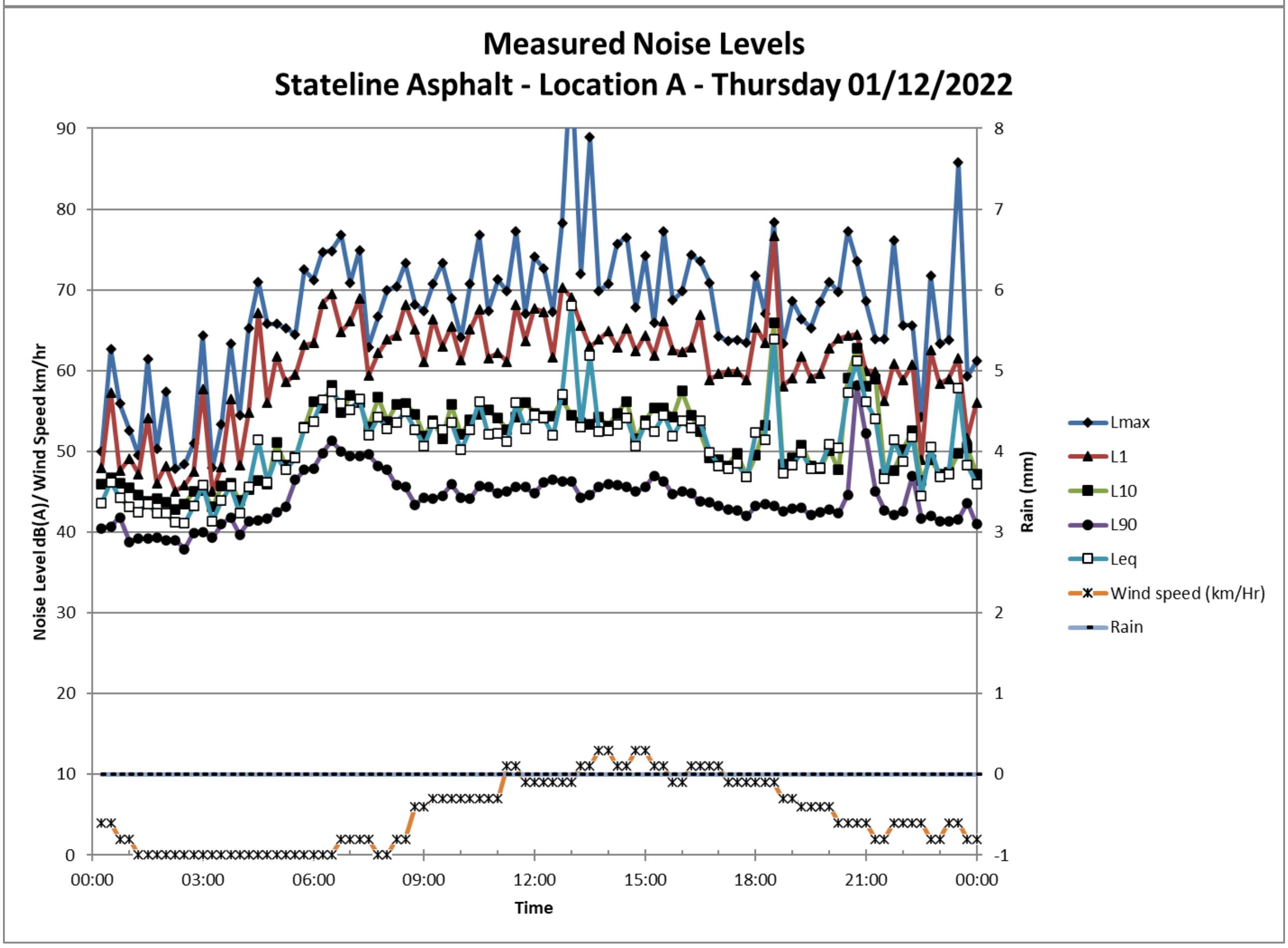
WEATHER CONDITIONS
It was partially cloudy, fine without significant breeze.

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

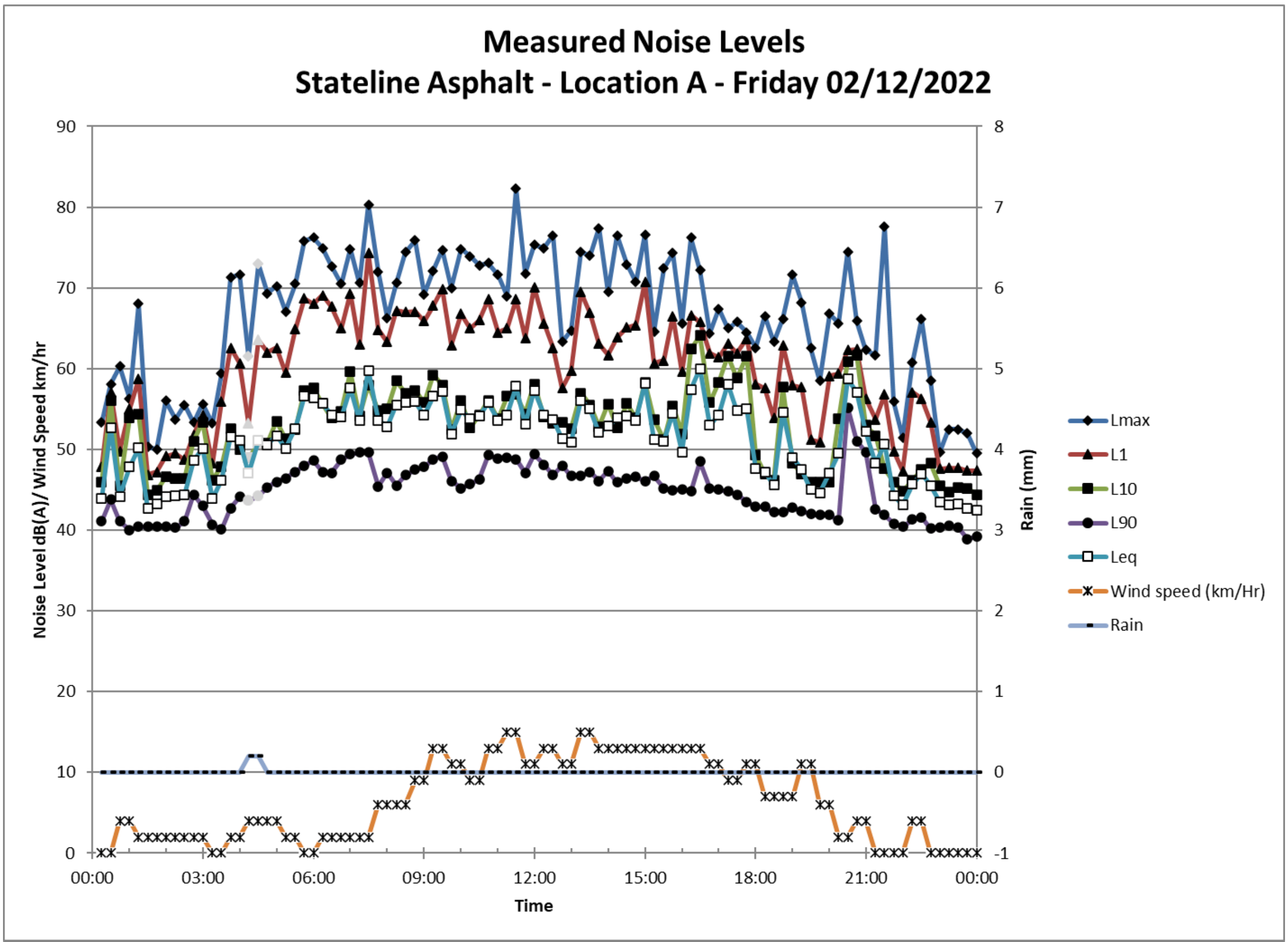
Attachment 4: Daily Noise Logger Charts

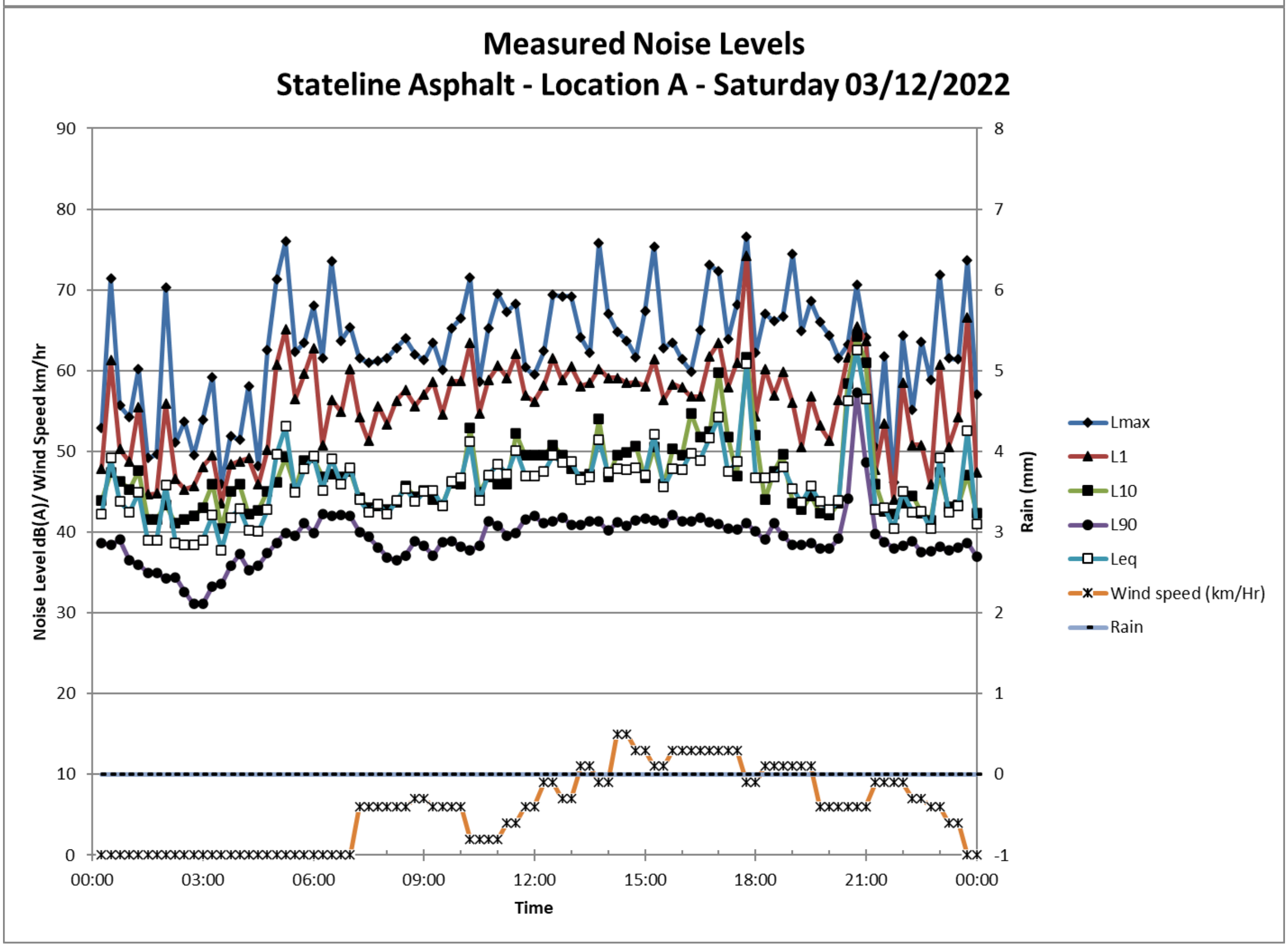


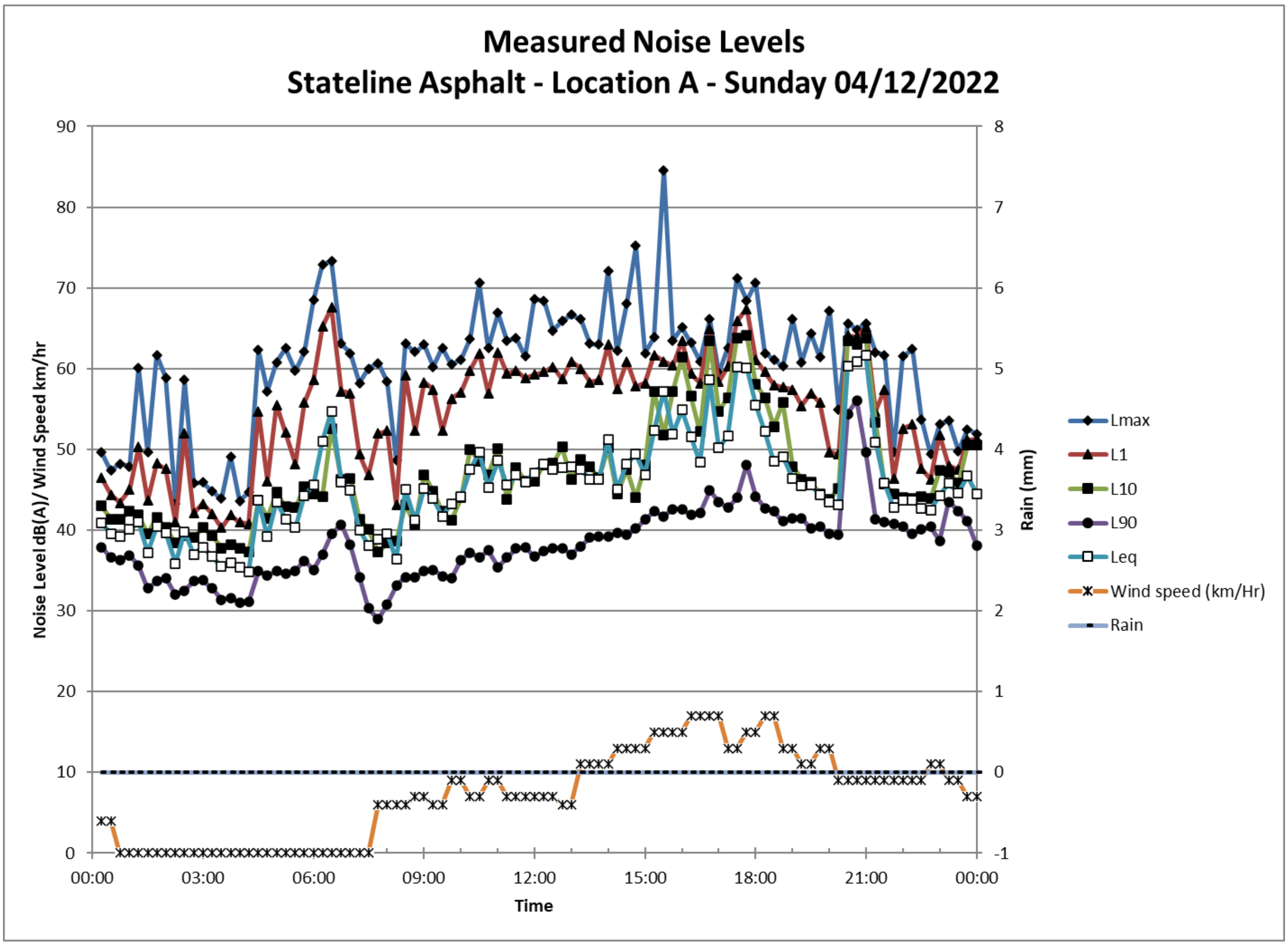
Measured Noise Levels
Stateline Asphalt - Location A - Wednesday 30/11/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

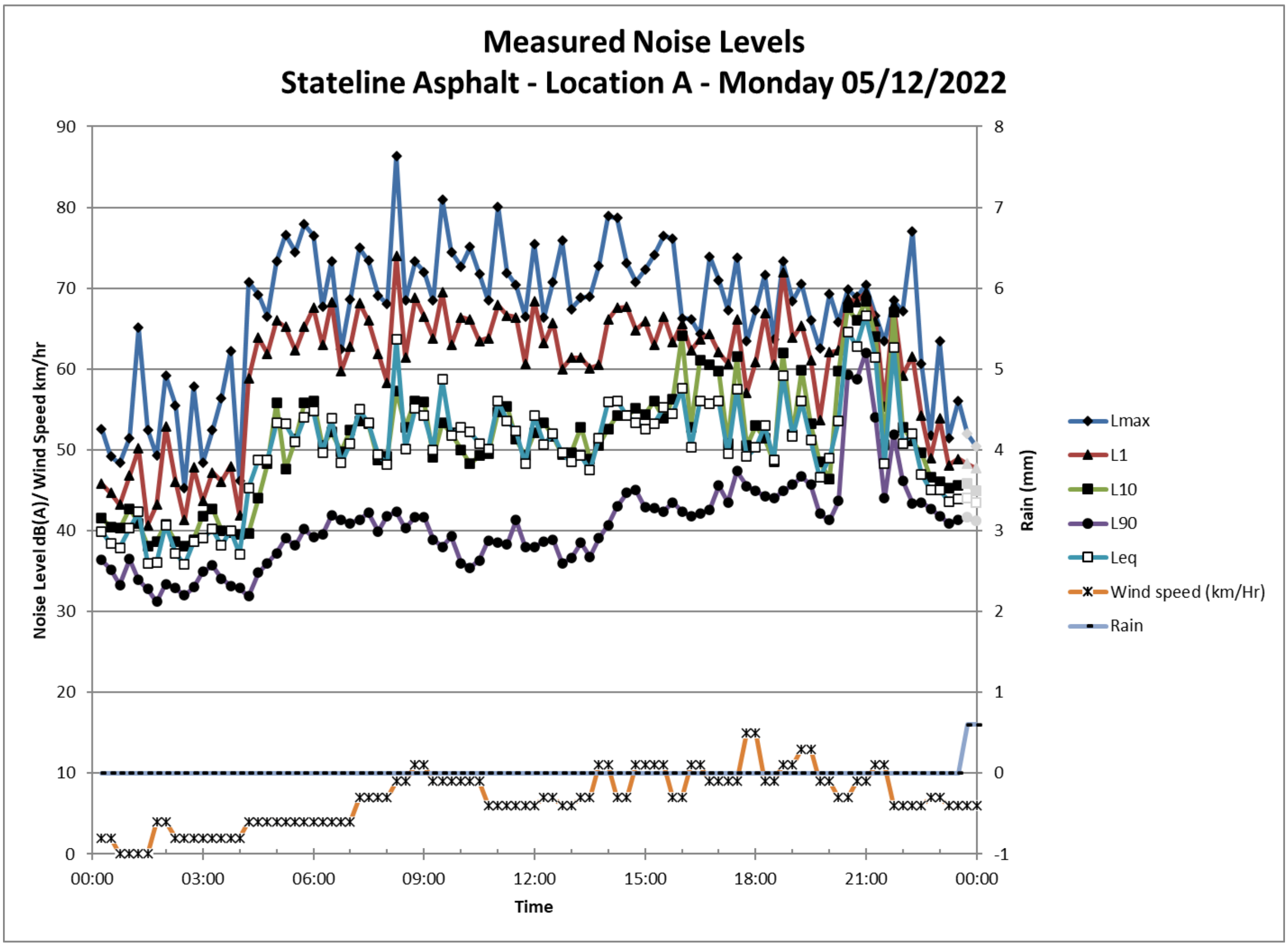


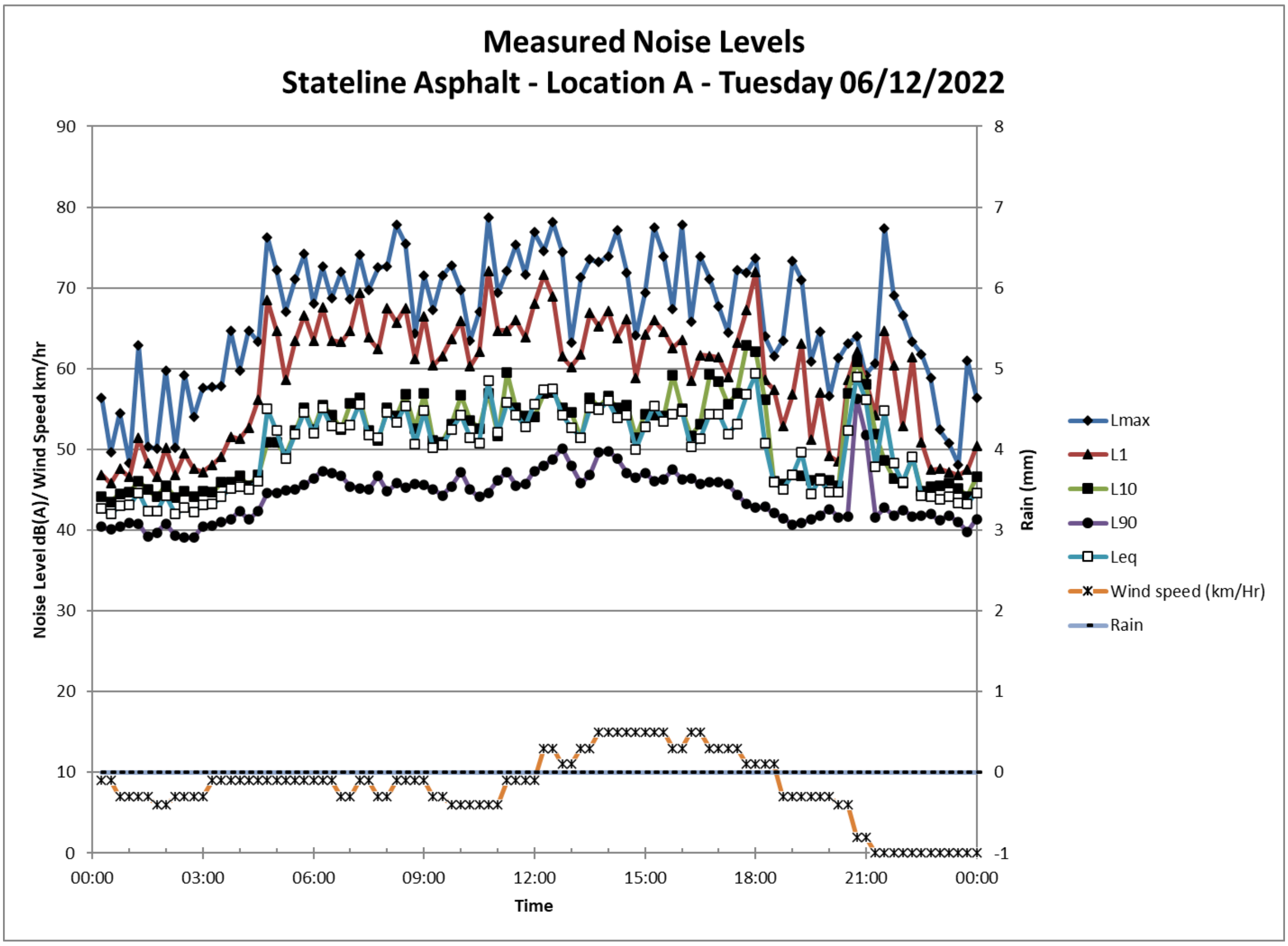
Measured Noise Levels
Stateline Asphalt - Location A - Thursday 01/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

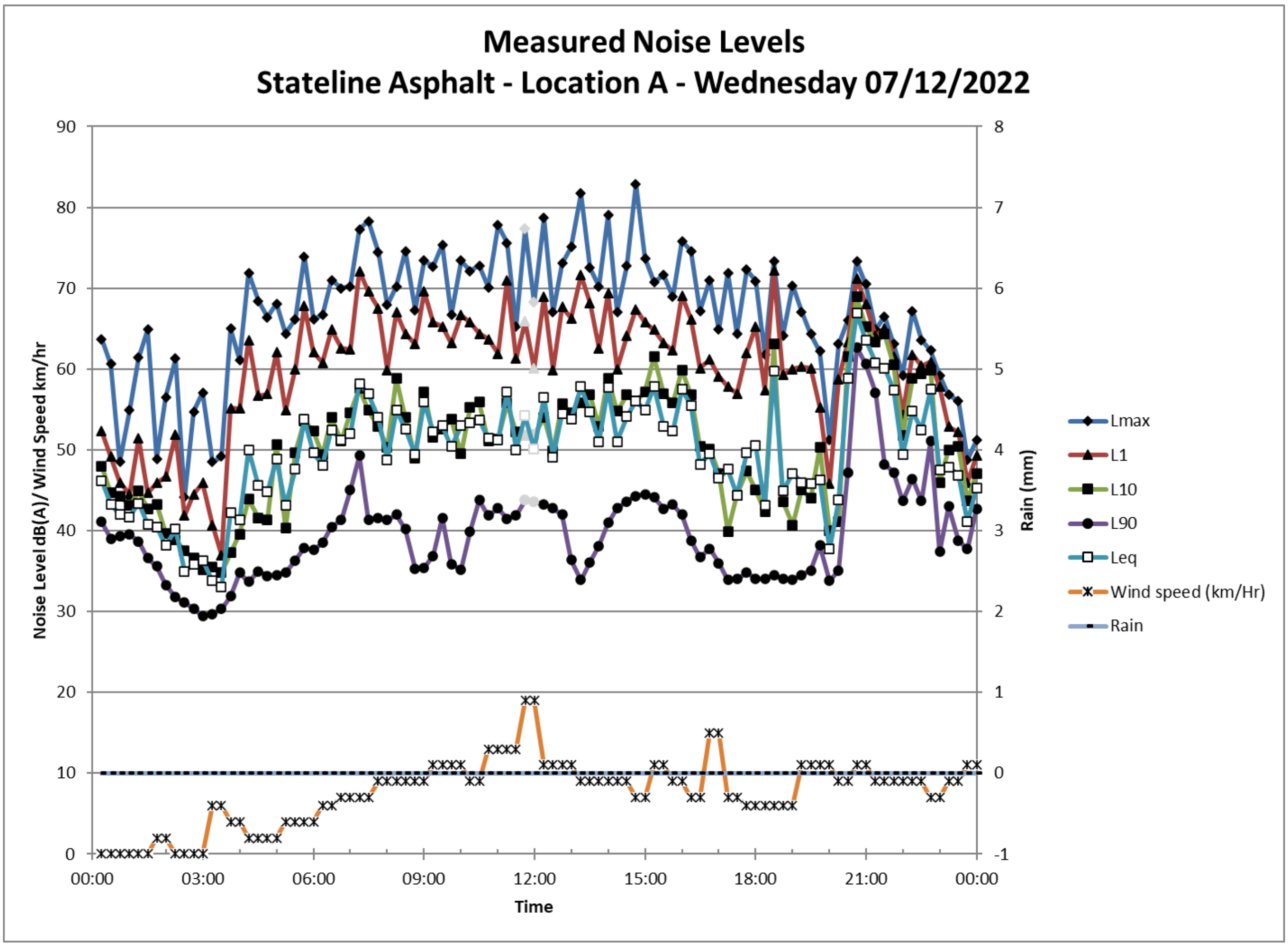

Measured Noise Levels
Stateline Asphalt - Location A - Friday 02/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

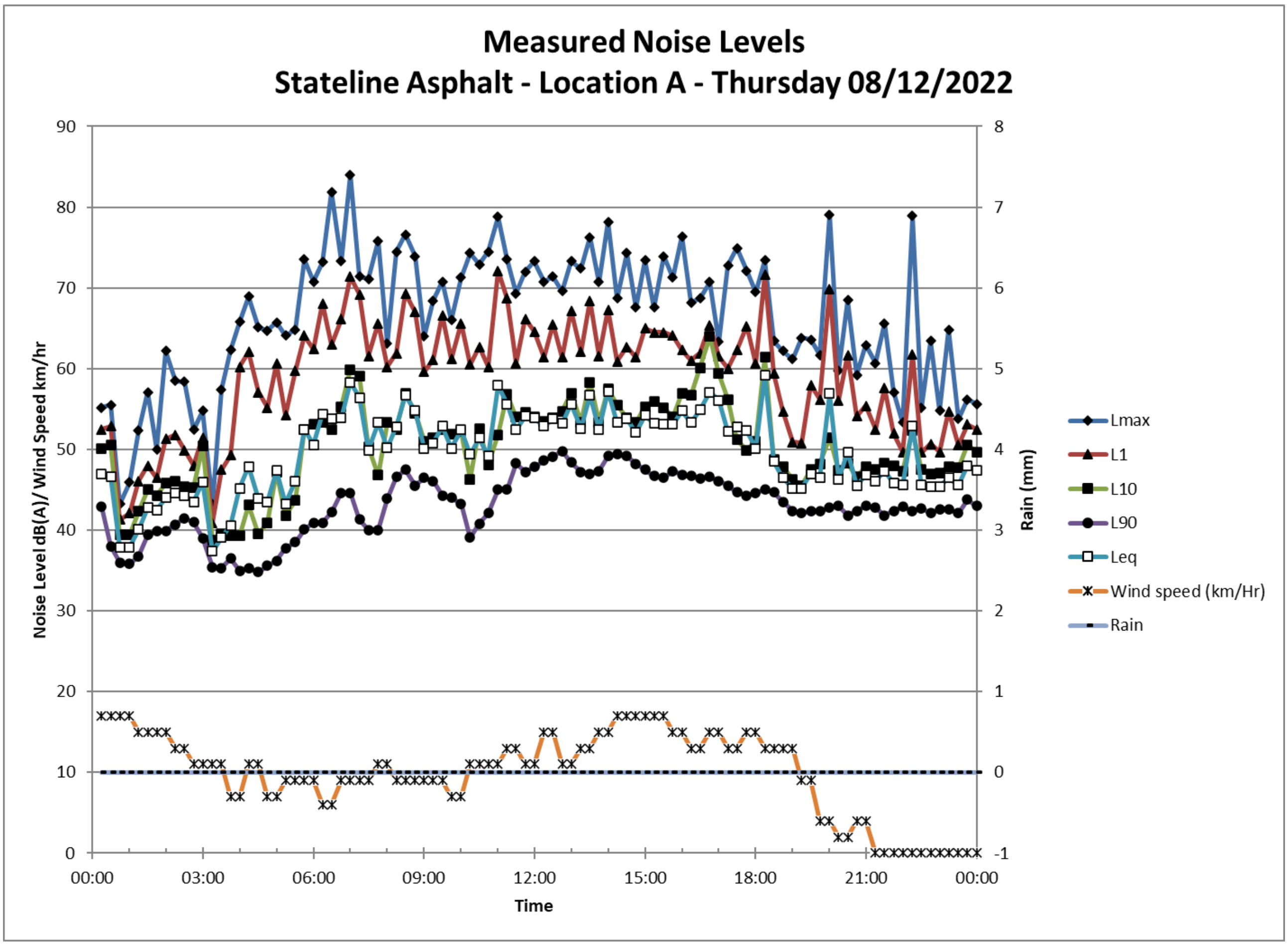

Measured Noise Levels
Stateline Asphalt - Location A - Saturday 03/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location A - Sunday 04/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location A - Monday 05/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location A - Tuesday 06/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location A - Wednesday 07/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location A - Thursday 08/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
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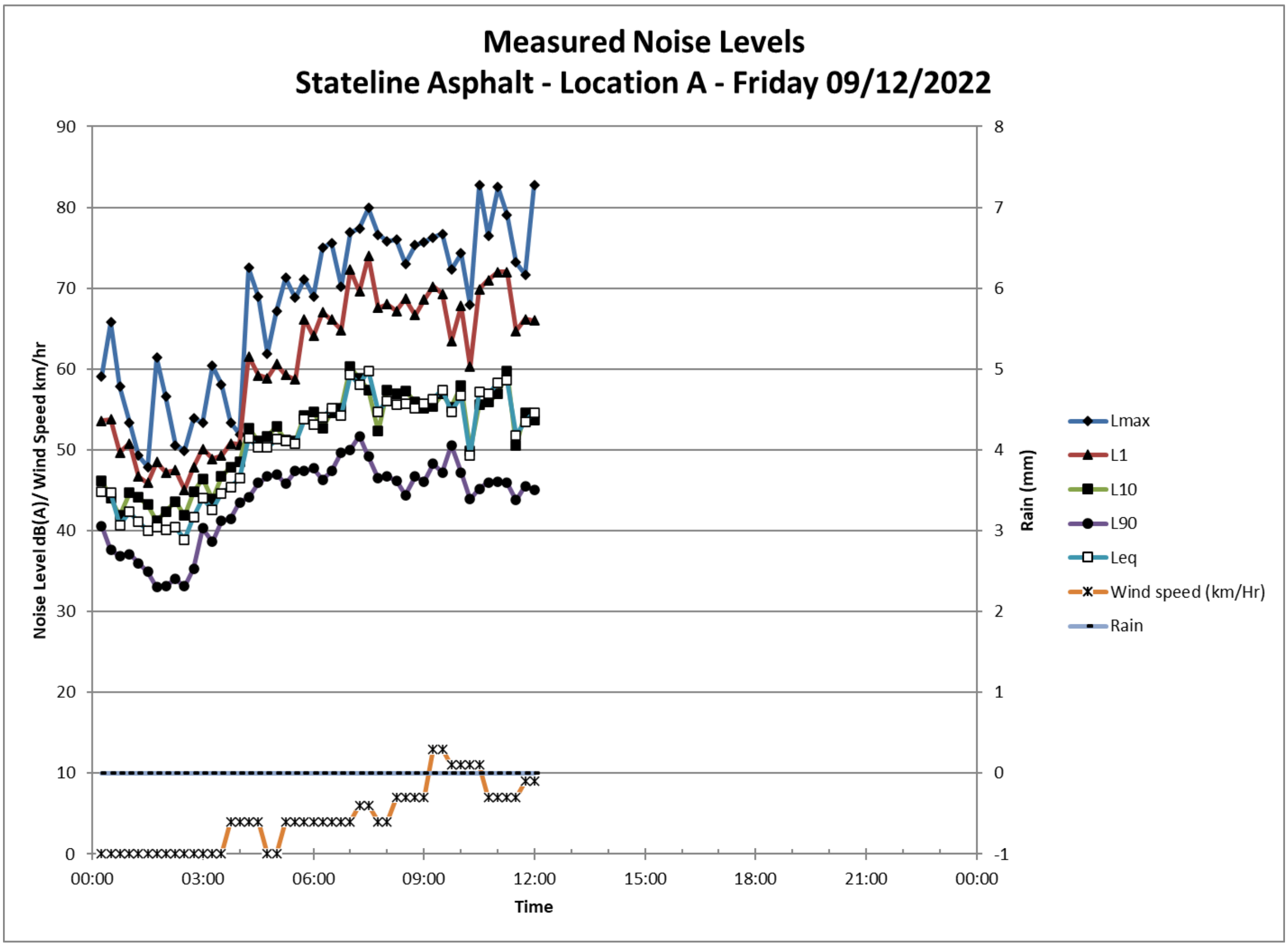
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location A - Friday 09/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
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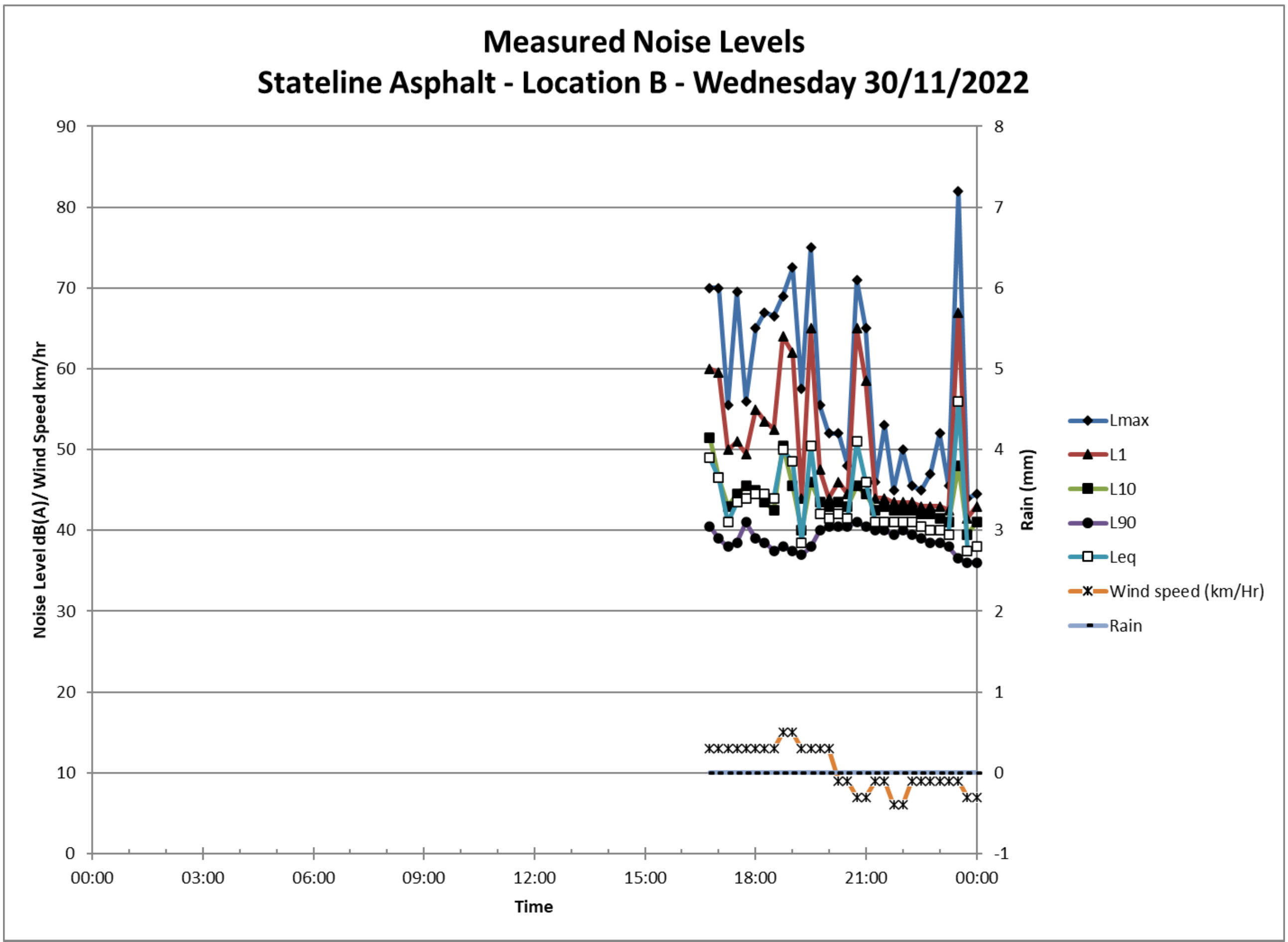
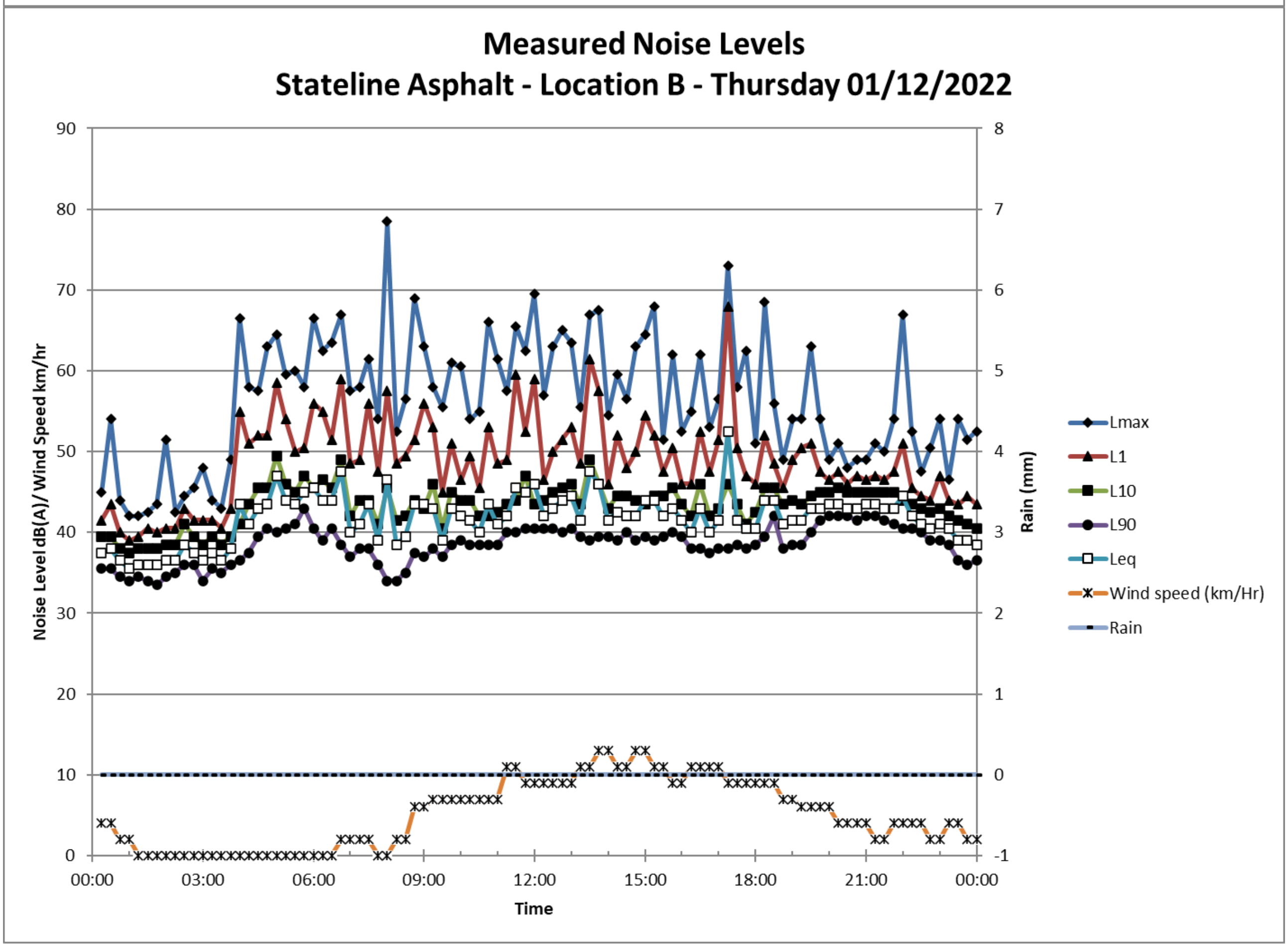
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Wednesday 30/11/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Thursday 01/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
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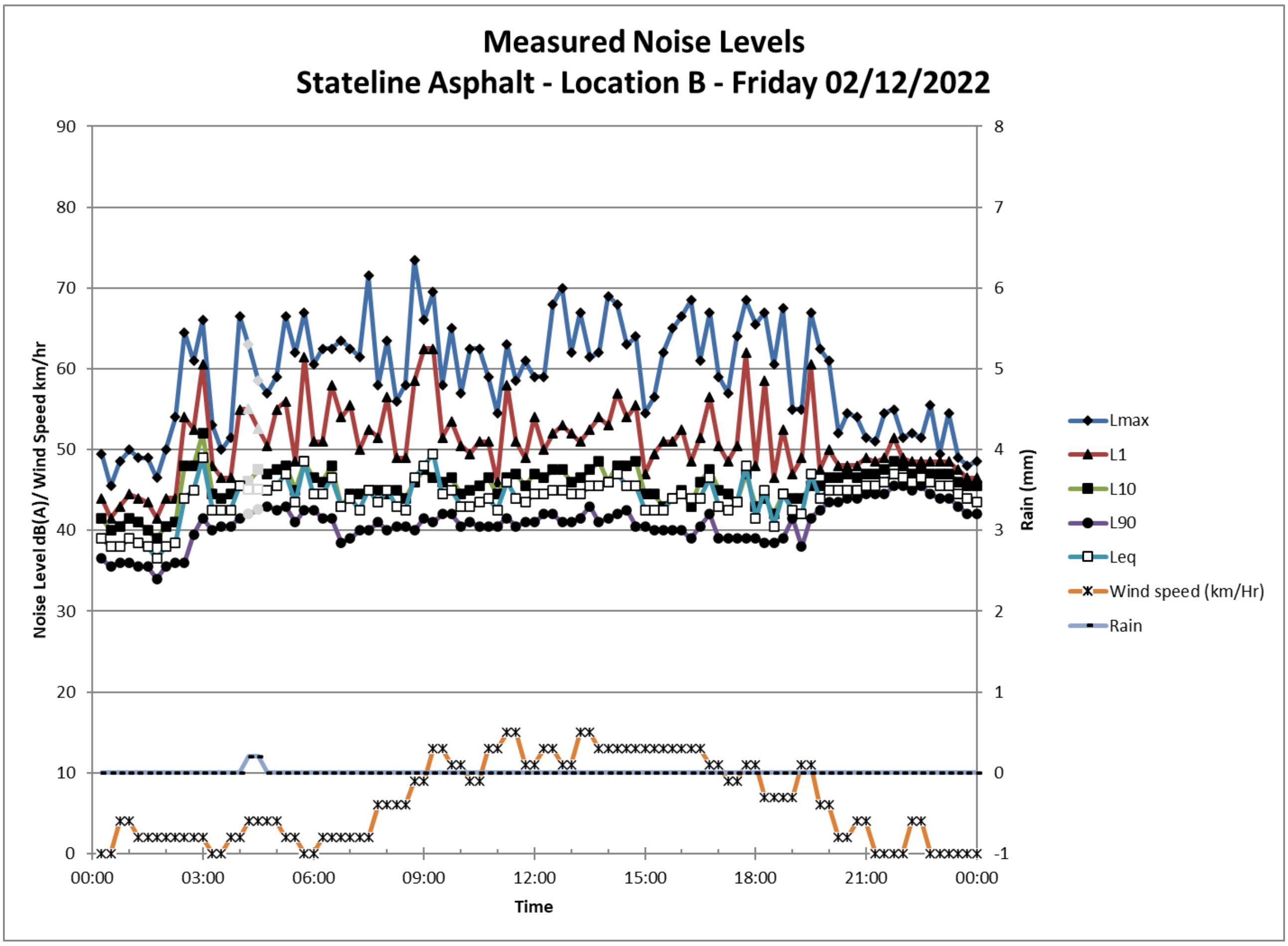
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Friday 02/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
80
70
60
50
40
30
20
10
0
8
7
6
5
4
3
2
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Lmax
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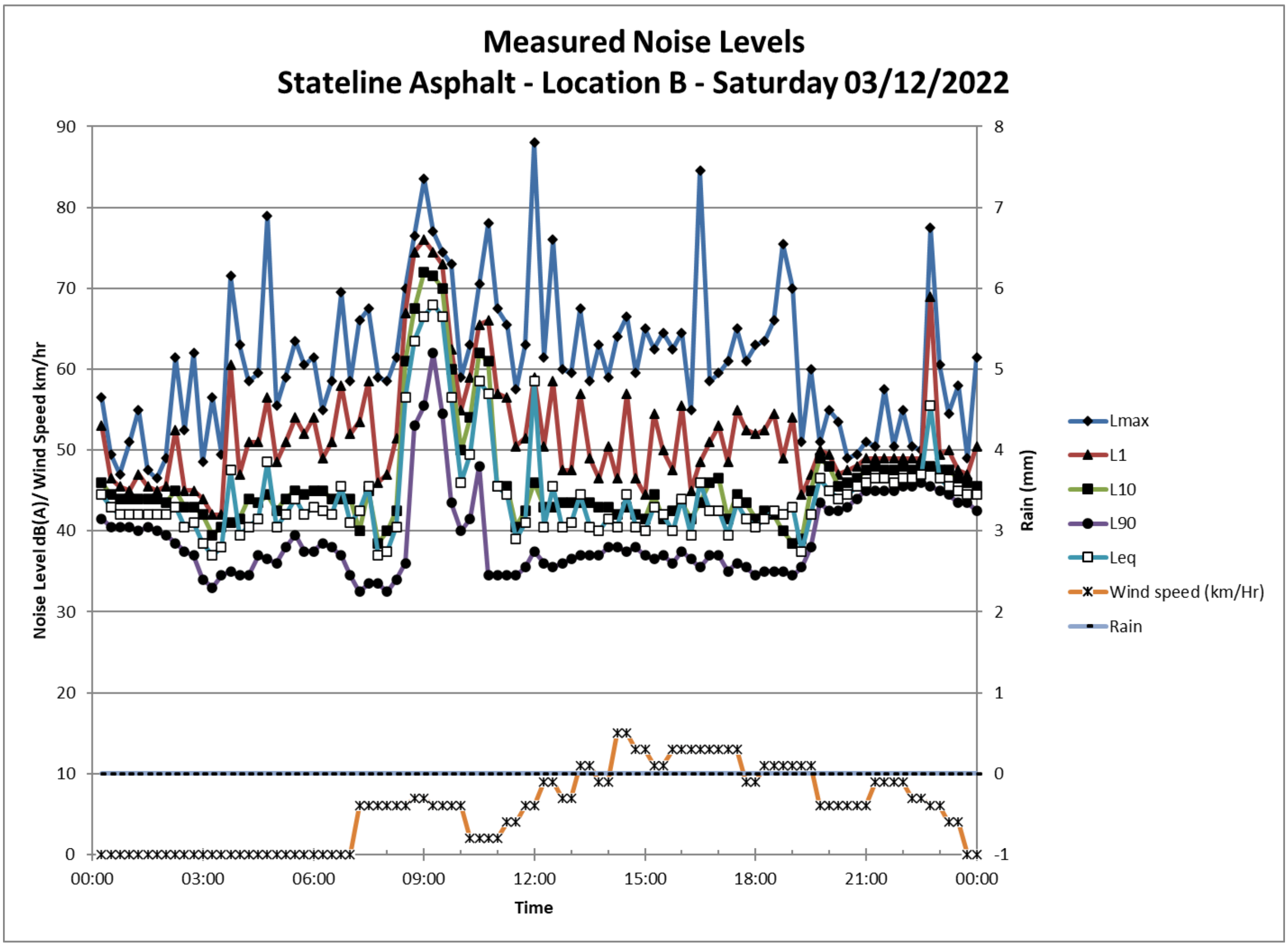
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Saturday 03/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
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Lmax
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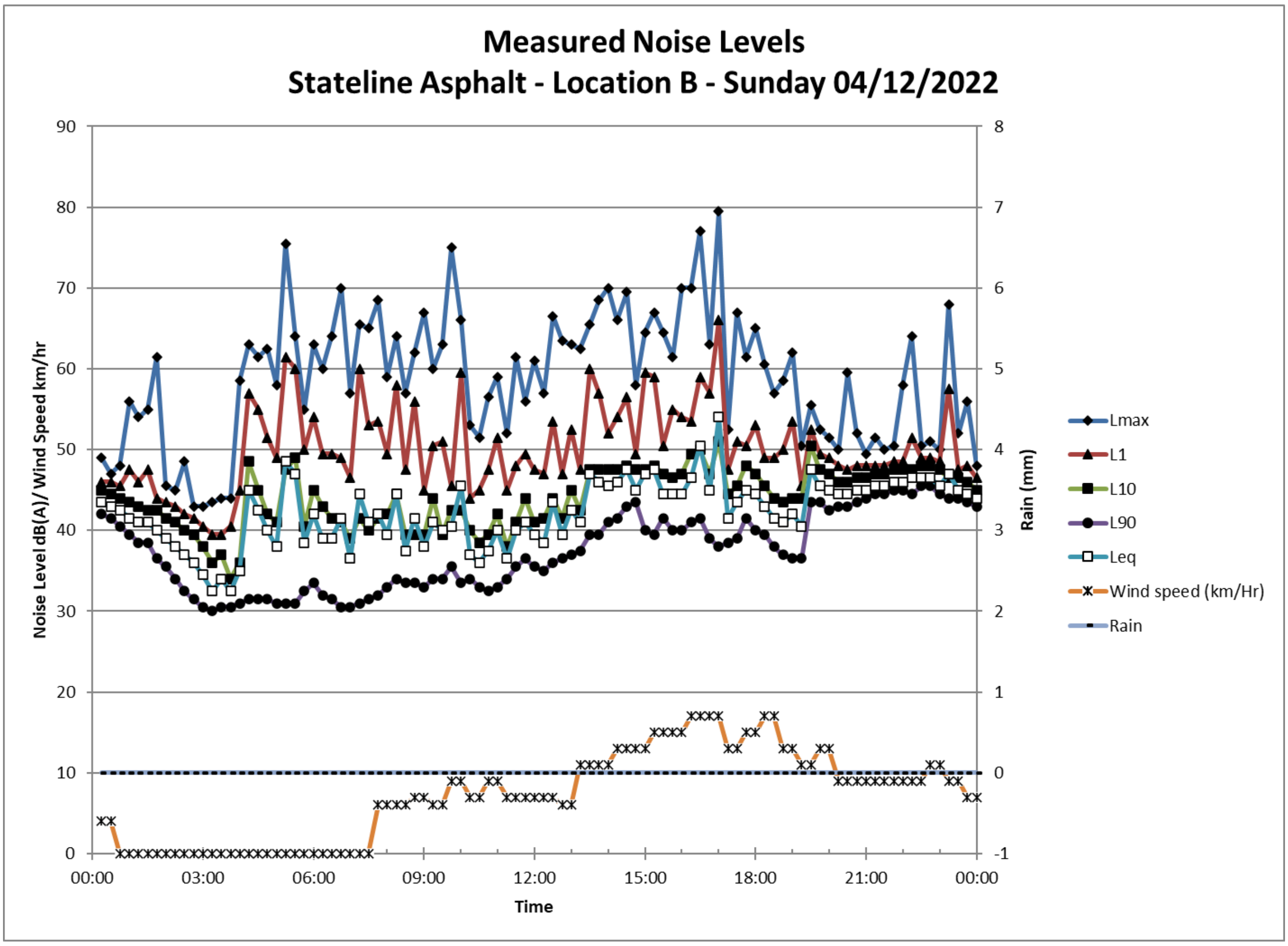
L90
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Sunday 04/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
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Lmax
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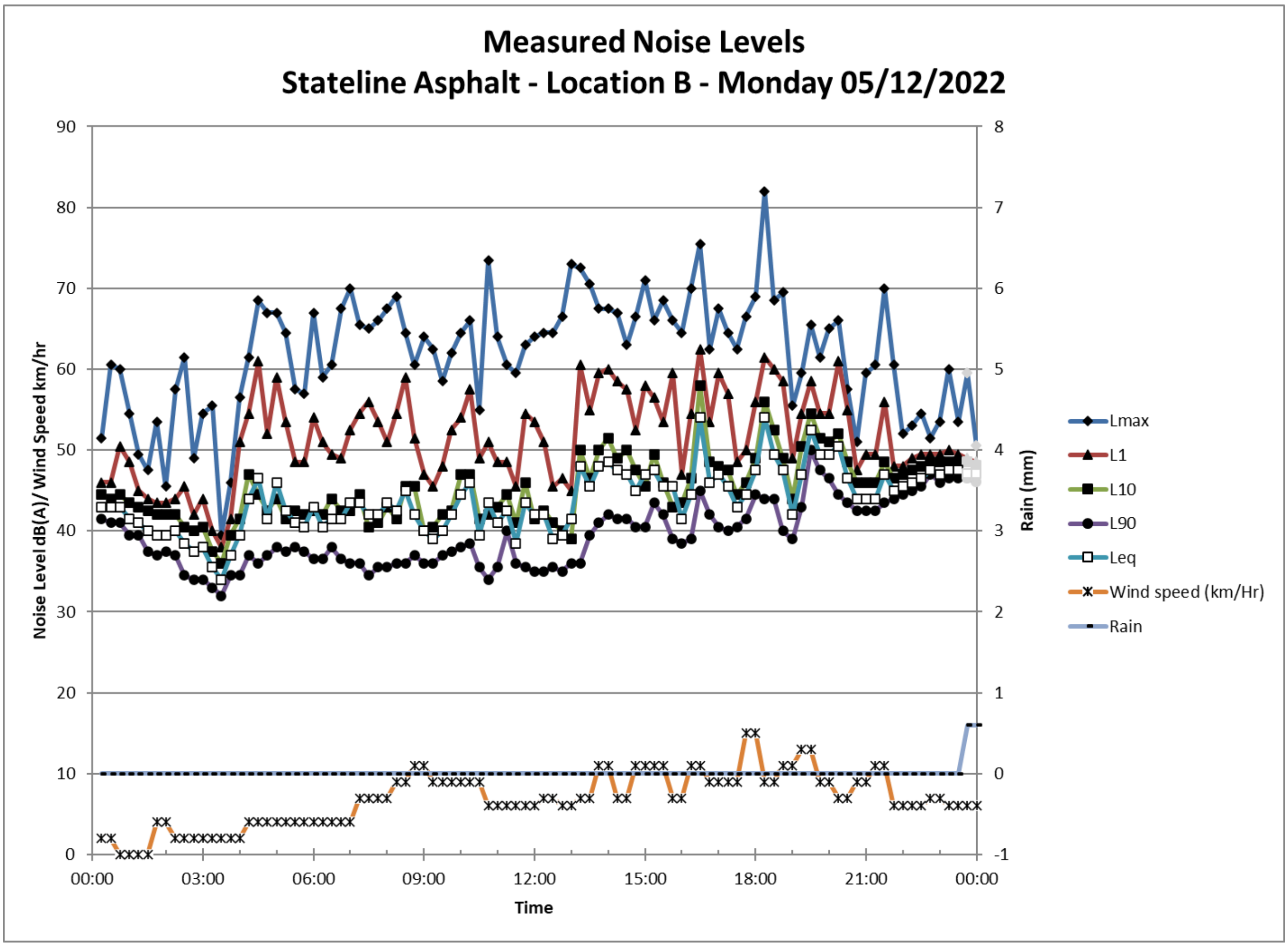
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Monday 05/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
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Lmax
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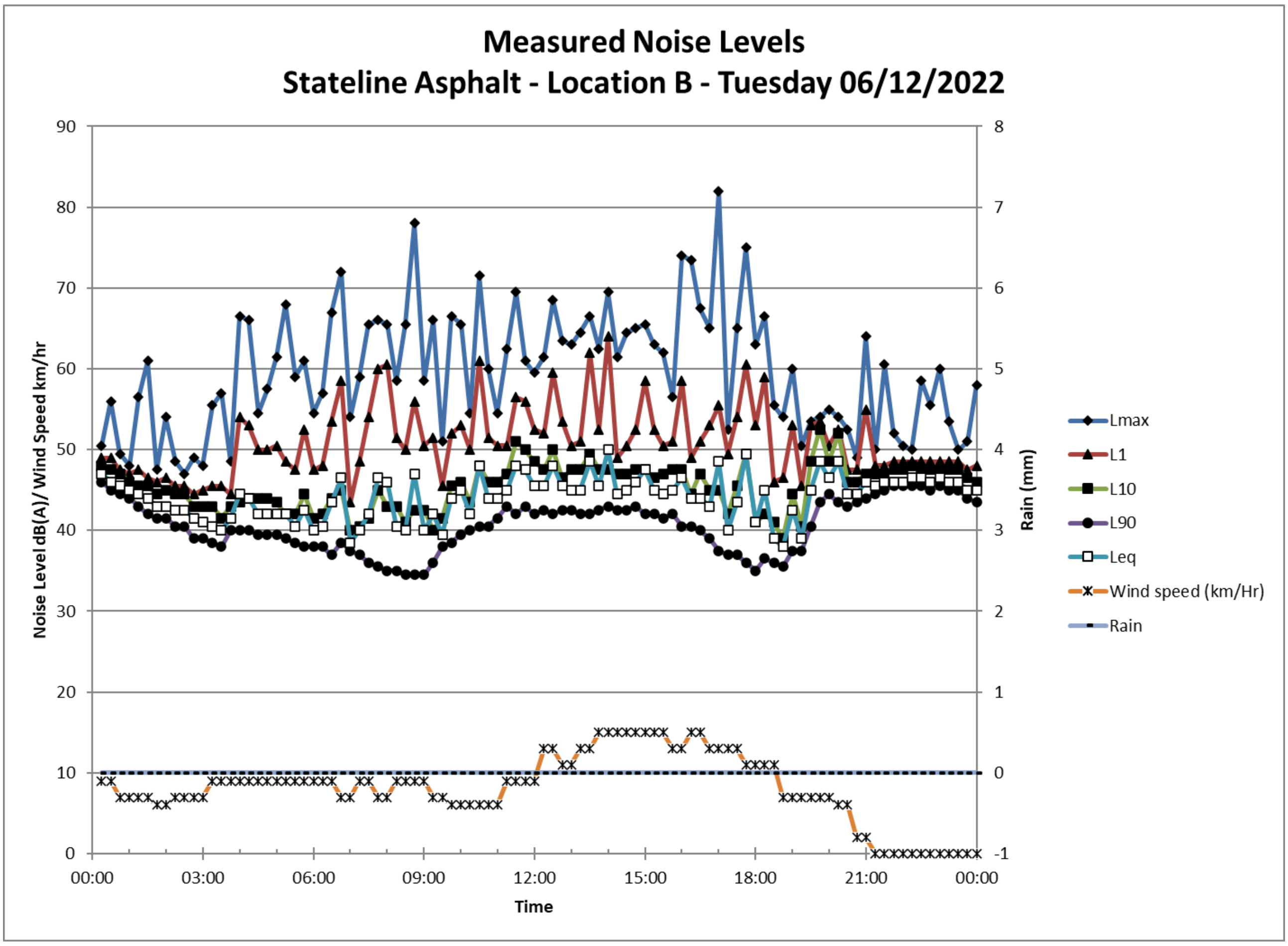
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Stateline Asphalt - Location B - Tuesday 06/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
06:00
09:00
12:00
15:00
18:00
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Lmax
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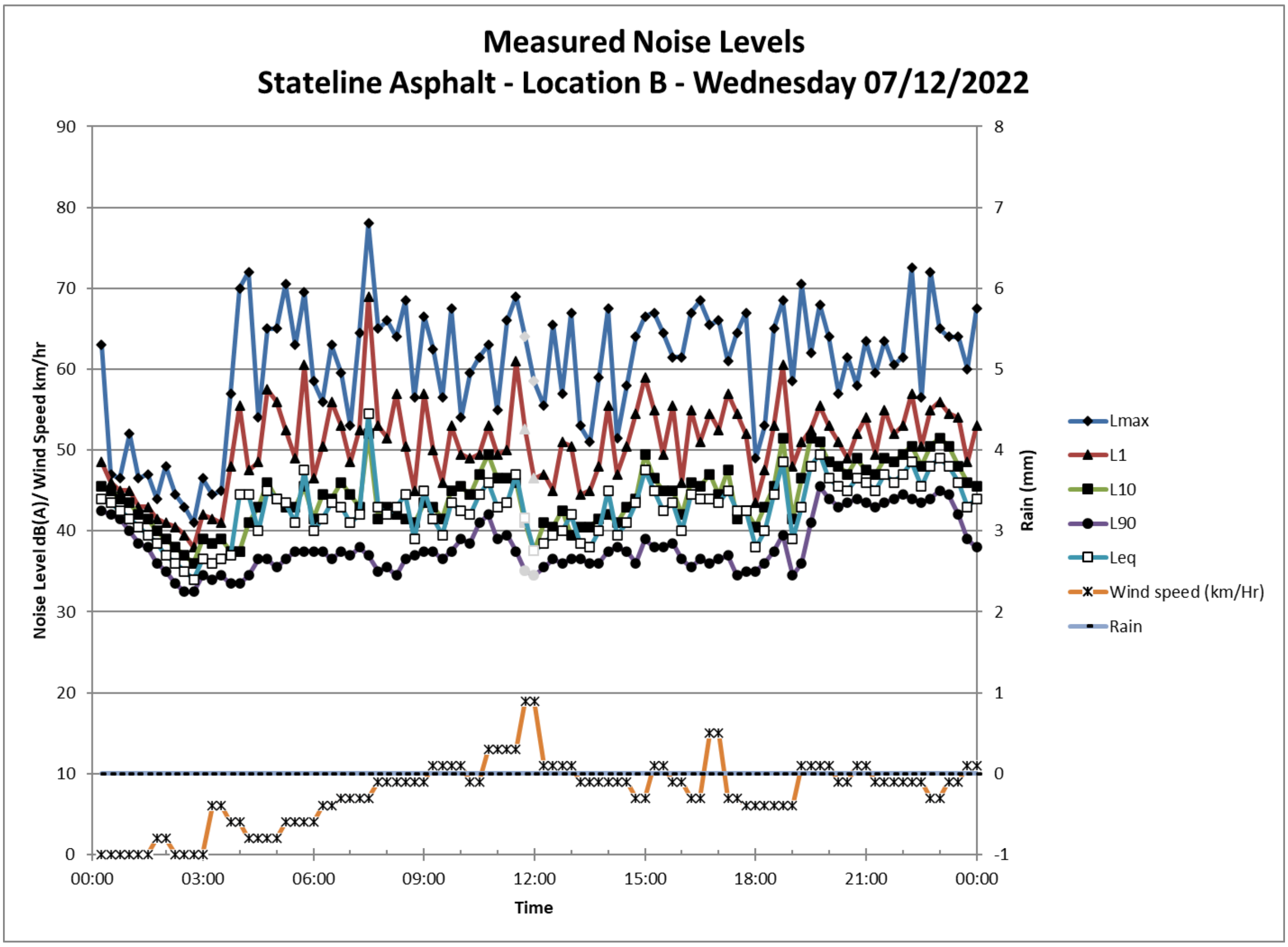
L90
Leq
Wind speed (km/Hr)
Rain



Measured Noise Levels
Stateline Asphalt - Location B - Wednesday 07/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
00:00
03:00
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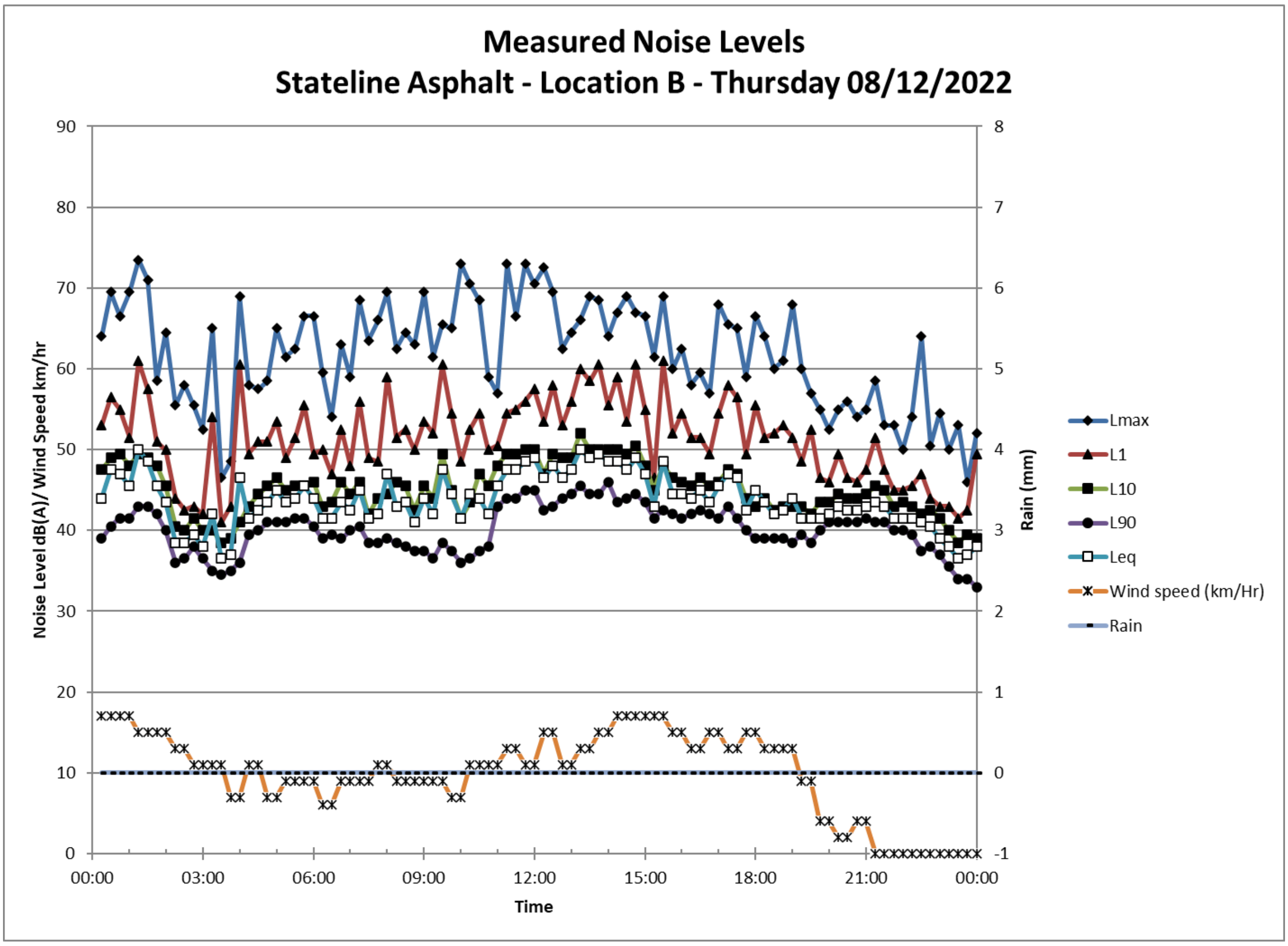
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Thursday 08/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
90
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Lmax
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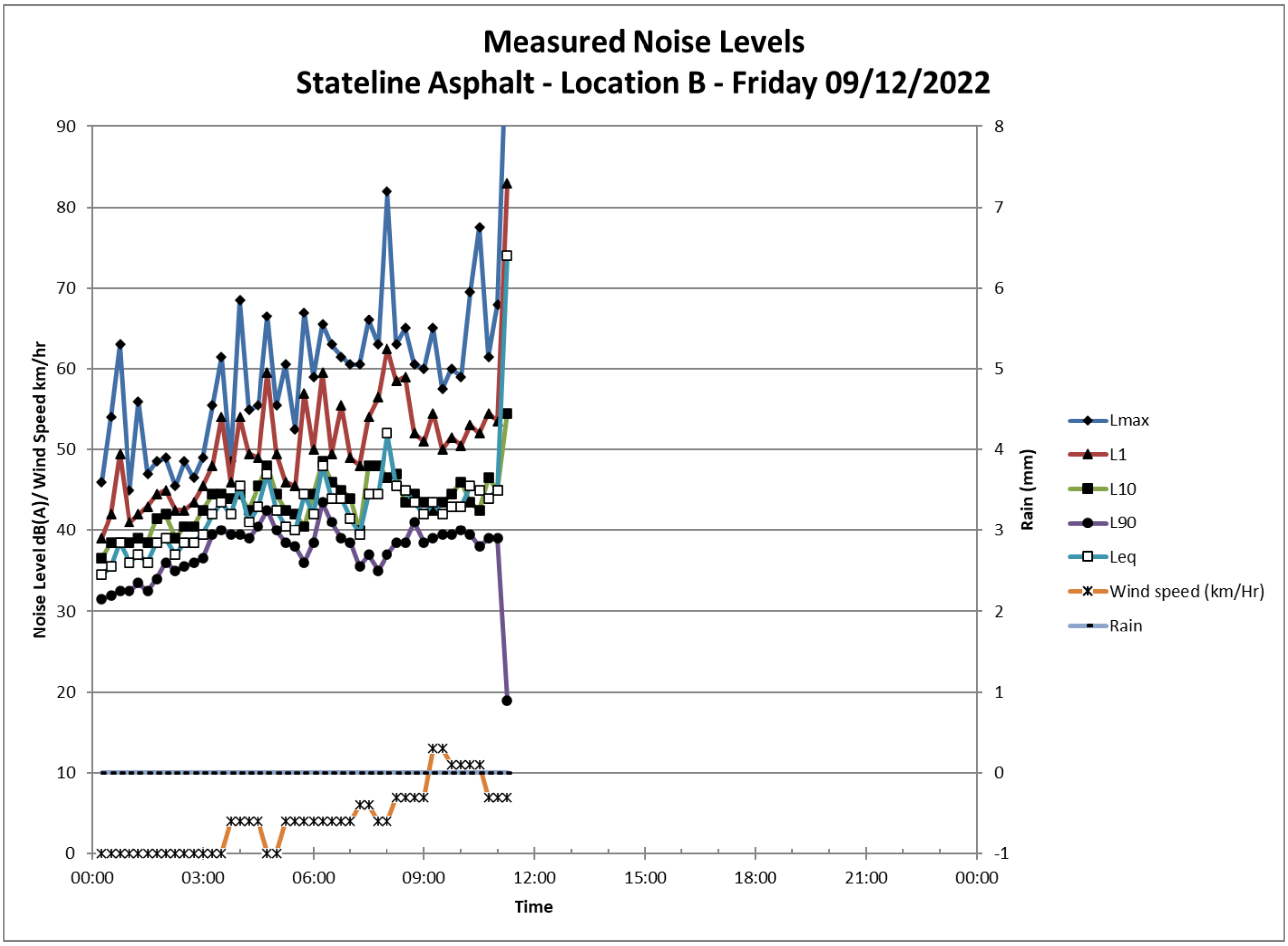
Leq
Wind speed (km/Hr)
Rain


Measured Noise Levels
Stateline Asphalt - Location B - Friday 09/12/2022
Noise Level dB(A)/ Wind Speed km/hr
Rain (mm)
Time
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21:00
00:00
Lmax
L1
L10
L90
Leq
Wind speed (km/Hr)
Rain

Attachment 5: Site Plans