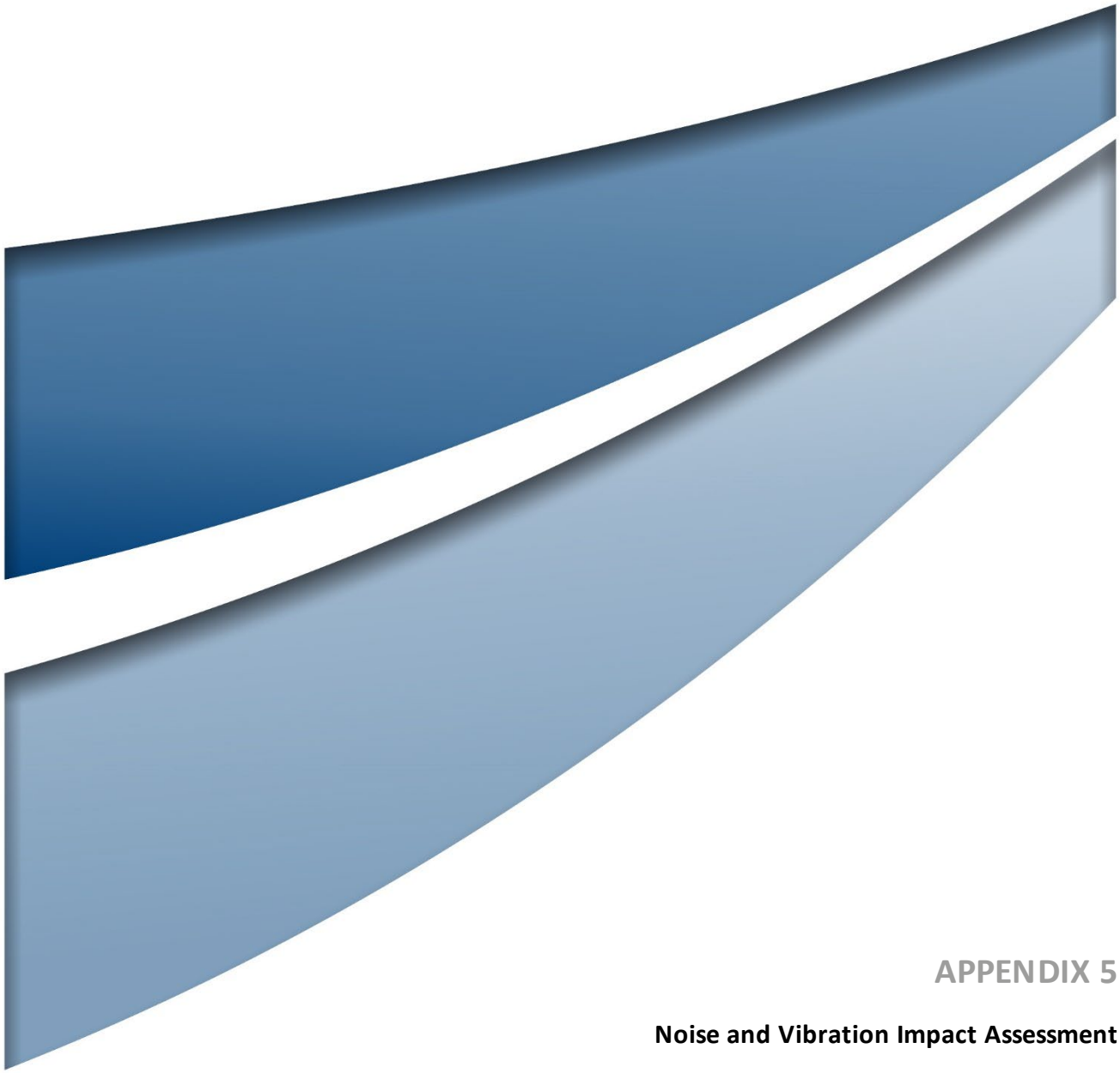

APPENDIX 5

Noise and Vibration Impact Assessment

umwelt
Environmental & Social Consultants

STONE RIDGE QUARRY

Noise Impact Assessment

FINAL

May 2023

STONE RIDGE QUARRY

Noise Impact Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Australian Resource Development Group Pty Limited

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Report No. R11
Date: May 2023

Environmental & Social Consultants

75 York Street Teralba NSW 2284

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	Tim Procter	29/05/2023	Penelope Williams	29/05/2023

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1.0 Introduction

Australian Resource Development Group Pty Limited (ARDG) is seeking to develop a new hard rock quarry, known as Stone Ridge Quarry (the Project), located within Wallaroo State Forest at Balickera NSW, approximately 25 kilometres (km) north of Newcastle within the Port Stephens Local Government Area (LGA).

This Noise Impact Assessment (NIA) forms part of the environmental Impact Statement (EIS). This report assesses noise and vibration impacts[1] during the construction and operational stages for the Project. It also proposes mitigation and management measures to reduce impacts during the construction and operation phases of the Project.

1.1 Project Overview

The Project is seeking to access a high quality, hard rock resource suitable for producing a wide range of quarry products for the Lower Hunter, Central Coast and northern Sydney construction material markets. The Project proposes to produce up to 1.5 million tonnes per annum (Mtpa) of saleable quarry product with approval sought for an initial 30-year quarrying period.

The Project is located on land managed by Forestry Corporation of New South Wales (FCNSW). In accordance with section 11 of the *Forestry Act 2012* (Forestry Act), FCNSW is responsible for "carrying out or authorising the carrying out of forestry operations on Crown-timber land or land owned by the Corporation". An additional function of FCNSW under section 11 of the Forestry Act is to "take or authorise the taking of forest materials" from this land. Forest materials are defined in the Forestry Act as "rock, stone, clay, shell, earth, sand, gravel or any like material". ARDG holds a Deed of Agreement (Deed) for a Forest Materials Licence (FML) with FCNSW under section 42 of the Forestry Act.

The construction phase of the Project consists of earthworks and clearing of vegetation for site preparation to enable access to target resources and development of the quarry extraction area. Construction of a weighbridge and associated administrative buildings combined with the installation of on-site processing plant and associated equipment are also required to facilitate the Project. A site access point off Italia Road would also need to be constructed. A summary of the of key project aspects is provided in **Table 1.1.**

The Project is a State Significant Development (SSD) under the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) as proposed extraction will exceed 500,00 tonnes per year. A development application (DA) for the Project is required to be submitted under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

[1] Blast vibration impacts are assessed under a separate Blast Impact Assessment

Table 1.1 Summary of Key Project Aspects

Aspect	Proposed for the Project
Construction Period	Up to 12 months
Quarry life	30 years from Commencement of extraction
Limits of production	Up to 1.5 Mtpa of quarry product/sales per year
Project Area	Approximately 139 ha (including extraction, processing and stockpiling area and buffers), with a disturbance area of approximately 79 ha
Extraction method	Drill, blast, load and haul
Material processing	Processing on site with provision for both mobile crushing and screening plant, as well as modular / fixed processing plant
Overburden management	Overburden will be minimal and any topsoil and overburden will be stockpiled on site for use in rehabilitation and/or water management structures and bunds
Product	Concrete, asphalt and sealing aggregates, gabion and crushed rock, armourstone and roadbase
Product transport	Road transport of up to 1.5 Mtpa of product via the Pacific Highway
Site access	Single access point on Italia Road. No trucks will turn right out of the site onto Italia Road towards East Seaham. No trucks will turn right out of Italia Road onto the Pacific Highway.
Employment	Construction: Operation: Up to 10 full time employees, 3 to 5 part-time employees
Hours of operation	Construction: • 7.00 am to 6.00 pm Monday to Friday • 8.00 am to 1.00 pm Saturday • No work on Sunday or public holidays Operation: • Quarrying and processing - 7.00 am to 6.00 pm Monday to Friday, and 7.00 am to 3.00 pm Saturdays • Truck loading, product transport and maintenance - 6.00 am to 10.00 pm Monday to Friday, and 7.00 am to 3.00 pm Saturdays No operation on Sundays or Public Holidays apart from maintenance activities as required
Rehabilitation and final landform	Rehabilitation will be undertaken progressively where appropriate in the context of further resources remaining available in the Project Area at the end of the planned 30-year approval life. A conceptual final landform will be prepared for the Project.

1.2 Project Location

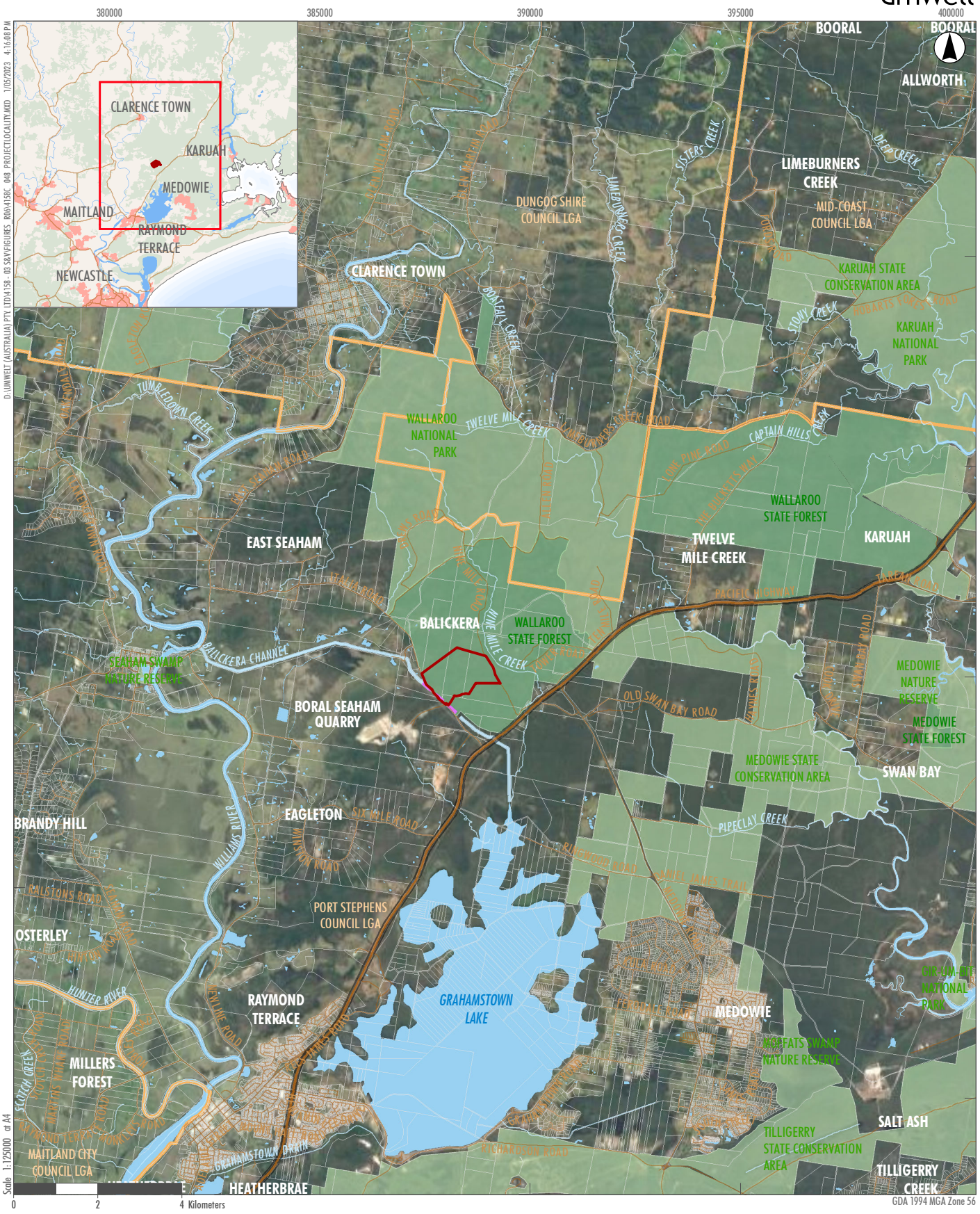
The Project is located within Wallaroo State Forest at Balickera, NSW, approximately 25 km north of Newcastle. Wallaroo State Forest is located on the northern side of the Pacific Highway, and extends from Italia Road, in the west, to the Karuah River in the east. The licence area covers 391 ha in the western part of Wallaroo State Forest (see **Figure 1.1**), immediately adjacent to Italia Road and to the immediate northeast of Boral's Seaham Quarry, which has been in operation since 1991.

The Project Area is located fully within the boundary of the licence area and comprises the portion of the licence area where quarry operations will occur. The current conceptual project design is shown in **Figure 1.2**.

The cadastre of the Project Area is described as follows:

- Lots 36 and 65 DP 753200
- Lot 1 DP 724372
- Part Lot 540 DP 1207159.

All lots are located on land managed by FCNSW.



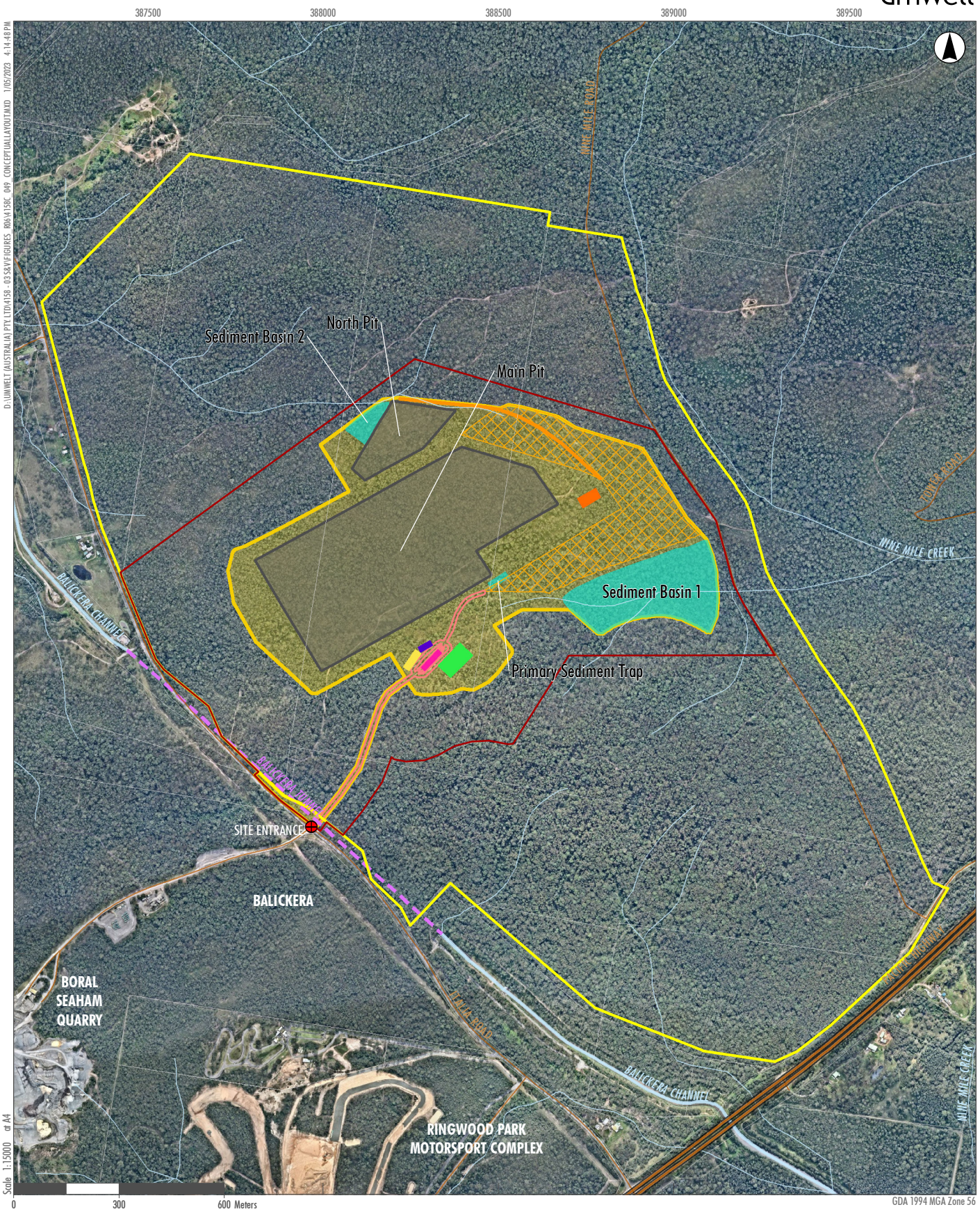
Legend

- Project Area
- LGA Boundary
- National Park / SCA / Nature Reserve
- State Forest
- Pacific Highway
- Road
- Balickera Tunnel
- Drainage Line
- Waterbody
- Lot Boundaries

Image source: ESRI Basemap (2021) Data source: NSW FSDF (2022)

FIGURE 1.1

Project Locality



Legend

- Project Area
- Disturbance Area
- Licence Area
- Pacific Highway
- Road
- Balickera Tunnel
- Drainage Line
- Lot Boundaries
- Pit Outlines (Stage 9)
- Office
- Weighbridge
- Access Road
- Northern Haul Road
- Workshop
- Truck Parking
- Light Vehicle Parking
- Stockpile and Plant Area
- Dams

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 1.2

Conceptual Project Layout

1.3 Assessment Requirements

This NIA has been carried out to address the requirements of the Secretary's environmental assessment requirements (SEARs). The SEARs for the Project are detailed in the SSD-10432 SEARs dated 1 June 2020, the SEARs relevant to the NIA are outlined in **Table 1.2**.

Table 1.2 Secretary's Environmental Assessment Requirements – Noise

Secretary's environmental assessment requirements		Section where addressed
Noise including:	- a detailed assessment of the likely construction, operational and off-site transport noise impacts of the development, including an assessment of cumulative impacts of any proposed, approved and existing developments in the vicinity of the site, prepared in accordance with the Interim Construction Noise Guideline, NSW Noise Policy for Industry and the NSW Road Noise Policy respectively, and having regard to the Voluntary Land Acquisition and Mitigation Policy;	Construction noise **Section 5.0** Operational noise **Section 4.0** Traffic noise **Section 6.0** Cumulative noise **Section 4.4.4**
	- reasonable and feasible mitigation measures to minimise noise emissions; and	Mitigation measures **Section 4.2** and **Section 7.0**
	- monitoring and management measures, in particular real-time and attended noise monitoring.	Monitoring and management **Section 7.0**

This NIA has been prepared in accordance with the following polices, guidelines and standards:

- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
- *Noise Policy for Industry* (NPfI) (NSW EPA, 2017)
- NSW Road Noise Policy (RNP) (DECCW, 2011)
- *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (VLAMP) (2018)
- *Assessing Vibration – A Technical Guideline* (AVTG) (DEC 2006)
- *Australian Standard AS 1055:2018 Acoustics—Description and measurement of environmental noise* (AS 1055:2018).

In addition, the NIA considers the submissions raised by the government agencies in relation to noise attached to the SEARs, as set out in **Table 1.3**.

Table 1.3 Agency Submissions Relating to Noise

Organisation	Submission	Section where addressed
EPA	Identify the existing noise environment (including any relevant noise assessment groupings) and identify applicable noise goals in line with relevant guidance/standards;	Existing noise environment **Section 2.0** Noise assessment framework and noise goals **Section 3.0**
	Identify potential noise and vibration sources and impacts during both construction and operational stages and identify best practice mitigation measures (pollution control) and strategies to be incorporated for both stages to minimise noise and vibration emissions/impacts (with proposed timing), including validation monitoring, in line with relevant guidance/standards; and	Construction noise **Section 5.0** Operational noise **Section 4.0** Traffic noise **Section 6.0** Mitigation measures **Section 4.2** and Section **7.0** Monitoring and management **Section 7.0**
	Propose representative noise monitoring locations for determining compliance with applicable noise goals and where relevant noise goals would be set as representative limits.	Monitoring and management **Section 7.0**
Port Stephens Council	An Acoustic Report will need to be prepared in support of the application and must take into consideration nearby sensitive receivers located in close proximity to the subject land, including residences in East Seaham.	Sensitive receivers **Section 1.4**
Transport for NSW	TfNSW makes reference to the document, *Roads and Maritime Services NSW's Guide to Traffic Generating Developments 2002,* which specifies that traffic noise is to be assessed.	**Section 6.0** provides a traffic noise assessment in accordance with the RNP.

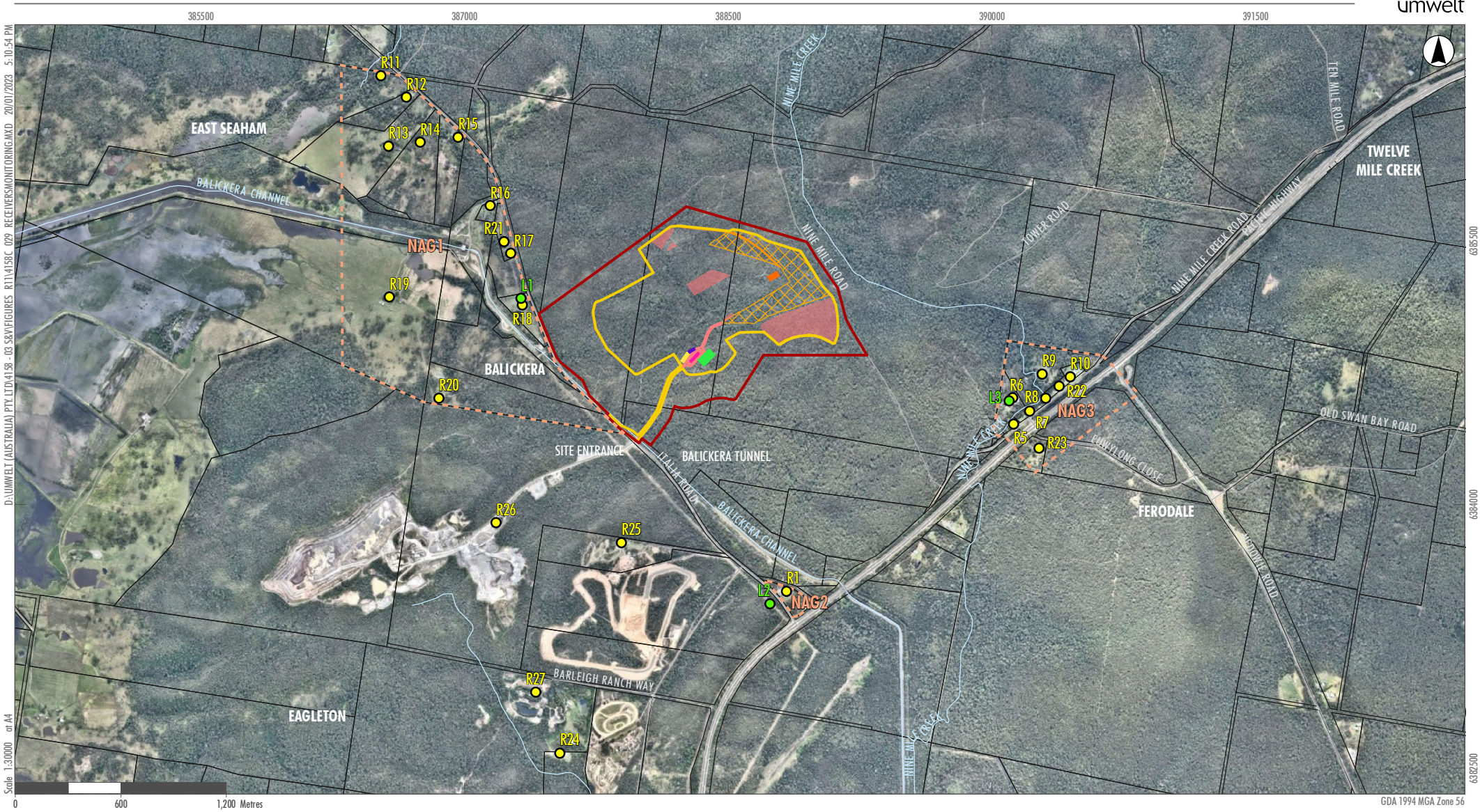
1.4 Noise Receivers

A comprehensive review of land ownership and receiver locations was undertaken as part of the NIA process. The receivers that could potentially be affected by noise from the Project are detailed in **Table 1.4** shown on **Figure 1.3**.

Additionally, the residential receivers in **Table 1.4** have been grouped into Noise Assessment Groups (NAGs), that have similar acoustic environments. This has been done to logically group the receivers to assist with the assessment and allocate the appropriate project noise trigger levels (PNTL) or management levels to each receiver. The NAGs are presented in in **Table 1.4** shown on **Figure 1.3**.

Table 1.4 Receivers and Noise Assessment Groups

ID	Receiver Type	Address / Description	Easting	Northing	Assigned NAG	Approximate Distance from Disturbance Boundary
R1	Residential	16 Italia Road, Balickera	388828	6383508	NAG_2	1210 m
R5	Residential	1 Nine Mile Creek Road, Ferodale	390115	6384452	NAG_3	1110 m
R6	Residential	5 Nine Mile Creek Road, Ferodale	390118	6384603		1040 m
R7	Residential	17 Nine Mile Creek Road, Ferodale	390217	6384528		1160 m
R8	Residential	9 Nine Mile Creek Road, Ferodale	390309	6384613		1220 m
R9	Residential	17 Nine Mile Creek Road, Ferodale	390284	6384740		1180 m
R10	Residential	13 Nine Mile Creek Road, Ferodale	390447	6384723		1340 m
R11	Residential	393 Italia Road East, Seaham	386530	6386433	NAG_1	1770 m
R12	Residential	379 Italia Road East, Seaham	386668	6386307		1580 m
R13	Residential	373 Italia Road East, Seaham	386567	6386037		1470 m
R14	Residential	361 Italia Road East, Seaham	386742	6386054		1380 m
R15	Residential	343 Italia Road East, Seaham	386959	6386085		1210 m
R16	Residential	299 Italia Road, Balickera	387145	6385697		810 m
R17	Residential	267 Italia Road, Balickera	387264	6385429		550 m
R18	Residential	241 Italia Road, Balickera	387318	6385155		400 m
R19	Residential	303 Italia Road, Balickera	386570	6385179		1150 m
R20	Residential	209B Italia Road, Balickera	386838	6384593		970 m
R21	Residential	267 Italia Road, Balickera	387220	6385498		620 m
R22	Residential	9 Nine Mile Creek Road, Ferodale	390384	6384672	NAG_3	1290 m
R23	Residential	7 Euwylong Close, Ferodale	390268	6384318		1300 m
R24	Active Recreation	11 Barleigh Ranch Way, Eagleton (Hunter Valley Paintball)	387544	6382583	n/a	1830 m
R25	Industrial	45 & 53 Italia Road, Balickera (Ringwood Park Motor Complex/Circuit Italia)	387893	6383781		580 m
R26	Industrial	139A & 139 Italia Road, Eagleton (Boral Quarry)	387178	6383895		880 m
R27	Industrial	13 Barleigh Ranch Way, Eagleton (Eagleton Quarry)	387405	6382931		1540 m



Legend

- Project Area
- Disturbance Area
- Noise Assessment Groups
- Noise Monitor Locations
- Sensitive Receivers
- Pacific Highway
- Road
- Drainage Line
- Lots
- Office
- Weighbridge
- Northern Haul Road
- Workshop
- Truck Parking
- Light Vehicle Parking
- Access Road
- Dams
- Stockpile and Plant Area

FIGURE 1.3

Sensitive Receivers and Noise Monitoring Locations

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

2.0 Existing Noise Environment

The site is located within a rural environment with typically low background noise levels. Existing noise sources include local road traffic, traffic from the Pacific Highway, agricultural activities and expected industrial contributions from Boral Seaham Quarry and Ringwood Park Motor Complex.

2.1 Environmental Noise Monitoring

2.1.1 Unattended Noise Monitoring

Unattended long-term noise monitoring was carried out at the three locations shown in **Table 2.1** and **Figure 1.3**. Location L1 was at a residence located on the western side of Italia Road, approximately 315 m west of the Disturbance Boundary, Location L2 was in proximity to the Italia Road and Pacific Highway intersection and Location L3 was at a residence located along Nine Mile Creek Road, approximately 1000 m southeast of the Disturbance Boundary.

These monitoring locations were selected to be representative of the potentially affected residential noise receivers within the respective NAGs. Note, access was sought but could not be acquired at 16 Italia Road, Balickera. Accordingly, a representative location for this residence was chosen (Location L2), which had a similar separation distance from Italia Road and the Pacific Highway.

Table 2.1 Noise monitoring locations

ID	Address / Description	Receiver Area	Monitoring Period	Location description [1]
L1	241 Italia Road, Balickera / Lot 223 DP605928	NAG 1	14/06/2022-24/06/2022	The logger was located in the front yard of the property. The microphone was located 1.5 metres above ground level in the free-field.
L2	45 Italia Road, Balickera / Lot 2 DP1158962	NAG 2	14/06/2022-24/06/2022	The logger was located on the western side of the powerline easement. The microphone was located 1.5 metres above ground level in the free-field.
L3	5 Nine Mile Creek Road, Ferodale / Lot 301 DP632130	NAG 3	14/06/2022-24/06/2022	The logger was located in the back yard of the property, near the western property boundary. The microphone was located 1.5 metres above ground level in the free-field.

Note: [1] Free-field is greater than 3.5 metres from reflective surfaces

Noise levels were measured in general accordance with AS1055:2018 and the requirements of the NPfI. The noise monitoring was conducted with Type 1, Svantek 977 Noise and Vibration Analysers. Field calibration checks were undertaken for the instruments pre and post logging and were found to be within 1 dB of the reference signal.

The ambient noise level L_{Aeq} for each period (Morning Shoulder (MS), Day, Evening and Night) has been calculated. Similarly, the Assessment Background Level (ABL) using the lowest 10th percentile method has been determined for each period (Day, Evening and Night) during each day. The Rating Background Level (RBL) has been evaluated as the median value of the ABL in each period (Day, Evening and Night).

The RBL values for the morning shoulder period were established in accordance with Fact Sheet A, Section A3 of the NPfI.

The noise data affected by extraneous noise, rain or wind exceeding 5 m/s were excluded from the noise data analysis, as per the procedures outlined in the NPfI Fact Sheet B. Meteorological data was obtained from the nearest Bureau of Meteorology (BOM) station, which was Williamtown RAAF (Station 061078) approximately 13 km southeast of the Project Area.

The results of the noise monitoring are summarised in **Table 2.2**. The full noise monitoring results are shown graphically in **Appendix B**.

Table 2.2 Noise Monitoring Results, dB(A)

ID	Rating Background Level (RBL) $L_{A90\ 15\ minute}$				Ambient noise level [2] $L_{Aeq,\ period}$			
	Day [1]	Evening [1]	Night [1]	MS [1,3]	Day [1]	Evening [1]	Night [1]	MS [1]
L1	31	31	27	28	54	55	46	51
L2	50	49	39	42	57	58	55	58
L3	50	49	42	42	56	56	54	56

Notes: [1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of morning shoulder or day period. Morning shoulder (MS) period is 6:00 am-7:00 am Monday-Saturday and 7:00 am-8:00 am Sunday and Public Holidays.

[2] In accordance with NPfI (Section 2.6), ambient noise levels are free-field noise levels (i.e. no correction from facade reflections)

[3] Shoulder period RBL levels determined as per NPfI Fact Sheet A3 (i.e. the lowest 10th percentile of $L_{AF90,15min}$ dB measurements for the equivalent of one weeks' worth of valid data taken over the shoulder period).

2.1.2 Attended Noise Monitoring

Attended noise monitoring was undertaken at Locations L1, L2 and L3 (see **Figure 1.3)** to supplement the unattended noise monitoring and get a better understanding of the noise sources that make up the existing noise environment. The attended measurements are summarised in **Table 2.3**.

The equipment used for the attended noise monitoring was a Type 1, Svantek 958 Noise and Vibration Analyser. Field calibration checks were undertaken for the instruments pre and post monitoring and were found to be within 1 dB of the reference signal.

Table 2.3 Attended Noise Level Measurements

ID	Address / location	Date/time	Measured noise level, dB(A)			Comments
			L_{Amax}	L_{Aeq}	L_{A90}	
L1	241 Italia Road, Balickera	24 June 2022 10:15 am – 10:30 am	72	55	46	The background noise level L_{A90} was controlled by natural noise sources (i.e wind in trees and frogs). The ambient noise level L_{Aeq} was controlled by natural noise sources and local traffic along Italia Rd. The recorded maximum noise level L_{Amax} was from local traffic along Italia Rd.

ID	Address / location	Date/time	Measured noise level, dB(A)			Comments
			L_{Amax}	L_{Aeq}	L_{A90}	
L2	45 Italia Road, Balickera	24 June 2022 9:53 am – 10:08 am	71	58	53	The background noise level L_{A90} was controlled by traffic along the Pacific Highway. The ambient noise level L_{Aeq} was controlled by traffic along the Pacific Highway, with some contribution from traffic along Italia Road. The recorded maximum noise level L_{Amax} was from traffic along the Pacific Highway.
L3	5 Nine Mile Creek, Ferodale	24 June 2022 9:21 am – 9:36 am	65	54	50	The background noise level L_{A90} and the ambient noise level L_{Aeq} was controlled by traffic along the Pacific Highway. The recorded maximum noise level L_{Amax} was from traffic along the Pacific Highway.

2.1.3 Road Traffic Noise Levels

Existing traffic noise levels were monitored at Location L2 and L3 and the results presented in **Table 2.4**. Noise levels have been presented in accordance with the RNP. Italia Road and the Pacific Highway are respectively classified as a sub-arterial road and freeway. The corresponding traffic noise descriptor and assessment period for these roads classifications are a daytime $L_{Aeq(15hour)}$ and a night $L_{Aeq(9hr)}$. In accordance with the RNP, a 2.5dB façade correction has been added to the measured free-field levels to represent an equivalent road traffic noise level at a 1m from the building facade.

Table 2.4 Measured Road Traffic Noise Levels, dB(A)

ID	Address	Measured Road Traffic Noise Level	
		Daytime [1] $L_{Aeq, 15hour}$	Night [1] $L_{Aeq, 9hour}$
L2	45 Italia Road, Balickera	60	58
L3	5 Nine Mile Creek, Ferodale	59	56

Note: [1] Daytime is 7:00 am-10:00 pm and Night is 10:00 pm-7:00 am.

3.0 Noise Assessment Framework

3.1 Operational Noise Assessment

The potential operational noise impacts of the Project have been assessed against the NPfI. The policy sets out a process for industrial noise management involving the following main steps:

- Determining the PNTL for a development (NPfI Section 2); these are the benchmark levels above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment (NPfI Section 2.3) and maintaining the noise amenity of an area (NPfI Section 2.4). Measurement of existing background levels, using procedures outlined in NPfI Fact Sheets A and B, is required for this step.
- Predicting or measuring the noise levels produced by the development (NPfI Section 3.3), having regard to the presence of annoying noise characteristics (NPfI Fact Sheet C) and meteorological effects such as temperature inversions and wind (NPfI Fact Sheet D).
- Comparing the predicted or measured noise level with the PNTL, and assessing impacts and the need for noise mitigation and management measures (NPfI Section 3.4).
- Considering residual noise impacts, that is, noise levels that exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant (NPfI Sections 3.2 and 4).
- Setting statutory compliance levels that reflect the best achievable and agreed noise limits for the development (NPfI Section 5).
- Monitoring and reporting environmental noise levels from the development (NPfI Section 7).

3.1.1 Noise Policy for Industry Assessment Noise Levels

The PNTLs derived in accordance with the NPfI provide a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The PNTL is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The PNTL, feasible and reasonable mitigation, and consideration of residual noise impacts are used together to assess noise impact and manage the noise from a proposal or site.

The PNTL is the lower (that is, the more stringent) value of the project intrusiveness noise level (PINL) and project amenity noise level (PANL) determined in the NPfI Sections 2.3 and 2.4. Neither the intrusiveness noise levels nor the amenity noise levels are used directly as regulatory noise limits.

3.1.1.1 Project Intrusiveness Noise Level

The Project Intrusiveness Noise Level (PINL) ($L_{Aeq(15\ minute)}$) is defined as the rating background noise level (RBL) + 5 dB. The RBL is determined by measurement of the long-term background noise level L_{A90} and calculated in accordance with the NPfI Fact Sheets A and B. However, the PINL for the evening period should not be set at greater than the PINL for the day period, and the PINL for the night period should not be set greater than the PINL for the day or evening periods.

The NPfI (Table 2.1) provides minimum assumed RBLs. If the RBLs derived from site measurements are lower than the minimum assumed RBLs, the PINLs are based on the minimum assumed RBLS, as shown in **Table 3.1**.

Table 3.1 Minimum Assumed RBLs and PINLs (NPfI Table 2.1)

Time of day [1]	Minimum assumed rating background noise level dB(A)	Minimum project intrusiveness noise level $L_{Aeq,15\ minute}$ dB(A)
Day period	35	40
Evening period	30	35
Night period	30	35

Note: [1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of day period.

The Project RBLs are derived as the greater of the measured RBLs shown in **Table 2.2** and the minimum assumed RBLs shown in **Table 3.1**.

The derived PINLs based on the RBLs are shown in **Table 3.2**.

Table 3.2 Derived Project Intrusiveness Noise Levels at Receivers $L_{Aeq(15\ minute)}$ dB(A)

NAG	RBL				PINL			
	Day [1]	Evening [1]	Night [1]	MS [1]	Day [1]	Evening [1]	Night [1]	MS [1]
NAG 1	35(31) [2]	31	30(27) [3]	35(28) [3]	40	36	35	40
NAG 2	50	49	39	42	55	54	44	47
NAG 3	50	49	42	42	55	54	47	47

Notes: [1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of morning shoulder or day period. Morning shoulder (MS) period is 6:00 am-7:00 am Monday-Saturday and 7:00 am-8.00 am Sunday and Public Holidays.

[2] Where the day RBLs are less than 35 dB(A) then RBL is set at 35 dB(A), actual measured RBL is in brackets ( ).

[3] Where the evening or night RBLs are less than 30 dB(A) then RBL is set at 30 dB(A), actual measured RBL is in brackets ( ).

3.1.1.2 Project Amenity Noise Levels

The Project Amenity Noise Level (PANL) ($L_{Aeq(period)}$) at receivers are defined as the recommended amenity noise levels in NPfI Table 2.2 minus 5 dB(A). For derivation of the PTNLs, the PANLs $L_{Aeq(period)}$ are converted to $L_{Aeq(15\ minute)}$ by the addition of 3 dB(A). The PANL at a receiver depends on the type of receiver and the noise amenity area of each receiver.

The residential receivers surrounding the Project Area are zoned RU2 Rural Landscape. The following receiver amenity land use categories have been adopted:

- Rural Residential land use category for all residences within NAG 1.

- Suburban Residential land use category for all residences within NAG 2 and NAG 3. Whilst these receivers have a RU2 zoning, due to the proximity to the Pacific Highway and high background noise levels, they have been classified as Suburban. With reference to Table 2.3 of the NPfI, based on measured background noise levels, whilst these receivers could technically be classified as Urban, a Suburban classification has been adopted due to decreasing traffic noise levels during the night period and Project noise at the receiver(s) emanating from an opposite direction to highway traffic noise.

The project PANLs for all receivers surrounding the project are shown in **Table 3.3**. In accordance with Section 2.4.1 of the NPfI, adjustments have been made where there is high traffic noise.

Table 3.3 Project Amenity Noise Levels, dB(A)

Receiver/ land use category	Time of day [1]	Recommended amenity noise level $L_{Aeq,period}$	Road Traffic Level $L_{Aeq,period}$	Project amenity noise level $L_{Aeq,period}$	Project amenity [2] noise level $L_{Aeq,15\ minute}$
NAG 1 Rural Residential	Day Period	50	n/a	45	48
	Evening Period	45	n/a	40	43
	Night Period	40	n/a	35	38
	Morning Shoulder	n/a	n/a	n/a	43 [3]
NAG 2 Suburban Residential	Day Period	55	57	50	53
	Evening Period	45	58	43 [4]	46
	Night Period	40	55	40 [4]	43
	Morning Shoulder	n/a	n/a	n/a	48 [3]
NAG 3 Suburban Residential	Day Period	55	56	50	53
	Evening Period	45	56	41 [4]	44
	Night Period	40	54	39 [4]	42
	Morning Shoulder	n/a	n/a	n/a	48 [3]
Active recreation area	When in use	55	n/a	50	53
Industrial	When in use	70	n/a	65	68

Notes:
[1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of morning shoulder or day period. Shoulder period is 6:00 am-7:00 am Monday-Saturday and 7:00 am-8.00 am Sunday and Public Holidays.

[2] The $L_{Aeq,period}$ project amenity noise level is represented as a 15-minute L_{Aeq} by the addition of 3 dB.

[3] The morning shoulder period PANL has been nominated as the halfway point between the day and night-time levels.

[4] The measured ambient noise levels were controlled by traffic noise. An assessment for amenity noise levels in areas of high traffic noise, in accordance with Section 2.4.1 of the NPfI has been undertaken and corrections applied.

3.1.1.3 Project Noise Trigger Levels

The PNTLs are defined as the lower (that is, the more stringent) of the PINL and the PANL in terms of $L_{Aeq(15\ minute)}$ noise levels. The PNTLs for each NAG are shown in **Table 3.4**. The PNTLs for the non-residential receivers are shown in **Table 3.5**.

Table 3.4 Project Noise Trigger Levels – Residential Receivers - $L_{Aeq(15min)}$, dB(A)

NAG	Period [1]	PINL	PANL	PNTL
NAG 1	Day	40	48	**40**
	Evening	36	43	**36**
	Night	35	38	**35**
	Morning shoulder	40	43	**40**
NAG 2	Day	55	53	**53**
	Evening	54	46	**46**
	Night	44	43	**43**
	Morning shoulder	47	48	**47**
NAG 3	Day	55	53	**53**
	Evening	54	44	**44**
	Night	47	42	**42**
	Morning shoulder	47	48	**47**

Notes: [1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of morning shoulder or day period. Shoulder period is 6:00 am-7:00 am Monday-Saturday and 7:00 am-8.00 am Sunday and Public Holidays.

[2] The shoulder period has been established as the background noise levels are steadily rising during these early morning hours. The objectives have been based upon the established intrusiveness and amenity noise levels.

Table 3.5 Project Noise Trigger Levels for Non-Residential Receivers – $L_{Aeq(15min)}$, dB(A)

Receiver	Period	PINL [1]	PANL	PNTL [2]
R24 - Hunter Valley Paintball	When in use	-	53	**53**
R25 - Ringwood Park Motor Complex/Circuit Italia[3]	When in use	-	68	**68**
R26 – Boral Quarry R27 – Eagleton Quarry	When in use	-	68	**68**

Notes: [1] PINL not applicable for non-residential receivers

[2] PNTL is only applicable when the receiver is in use

[3] Characterised as industrial development due to nature of activities undertaken at the site and associated noise impacts.

3.1.1.4 Correction Factors

Where a noise source contains characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Conversely, some noise sources may cause less annoyance where only a single event occurs for a limited duration.

Fact Sheet C of the NPfI outlines how correction factors should be applied to source noise levels at the receiver before comparison with the respective project noise trigger levels. These correction factors account for the additional annoyance caused by the factors that modify the noise.

The assessment of modifying factors and application of correction factors for annoying noise characteristics are discussed in **Section 4.4.6**.

3.1.2 Maximum Noise Event Assessment Levels (Sleep Disturbance)

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. According to the NPfI, where the development's night-time noise levels at a residential location exceed:

- $L_{Aeq,15minute}$ 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 event assessment should be undertaken.

The sleep disturbance assessment levels for each NAG are provided in **Table 3.6**.

Table 3.6 Sleep Disturbance Assessment Levels - Residential Receivers, $L_{Aeq,15minute}$ and L_{AFmax} dB(A)

NAG	Morning Shoulder Period (6:00 am – 7:00 am)	
	Assessment Level $L_{Aeq,15minute}$	Assessment Level L_{AFmax}
NAG 1	40 [1]	52 [2]
NAG 2	47 (42 +5)	57 (42 +15)
NAG 3	47 (42 +5)	57 (42 +15)

Notes: [1] As per NPfI Section 2.5, minimum sleep disturbance assessment level is the greater of $L_{Aeq, 15minute}$ 40 dB(A) or RBL + 5dB. In this case RBL + 5 lower than 40dB.

[2] As per NPfI Section 2.5, minimum sleep disturbance assessment level is the greater of L_{AFMax} 52 dB(A) or RBL + 15dB. In this case RBL + 15 lower than 52dB.

3.1.3 Cumulative Noise Criteria

The other industries in the local area that have the potential to contribute to project noise levels, include Ringwood Park Motor Complex (a car club), Boral Quarry, Eagleton Quarry (proposed) and Hunter Valley Paintball, which are all located on the western side of Italia Road. Operational noise from Hunter Valley Paintball, which is located approximately 1.5km southwest of Italia Road, is expected to be negligible.

As specified in the NPfI, the recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas PANL represents the objective for noise from a single industrial development at a receiver location. For this Project, by adopting a PANL that is 5 dB below the recommended amenity noise level, ensures that industrial noise levels from up to three or four industrial noise sources (as in the case for this Project) remain within the recommended amenity noise level for an area.

For NAG 2 and NAG 3, for the periods controlled by high traffic noise an adjustment of 15dB lower than the road traffic L_{Aeq} was applied. No further reduction is required, as this already allows for cumulative noise from three or four industrial noise sources.

Further, Section 2.4 of the NPfI states:

> *Where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required.*

In accordance with the NPfI, predicted compliance with the established PANL will consequently address cumulative noise. For clarity, the cumulative noise limits are specified in **Table 3.7**.

Table 3.7 Cumulative noise criteria – $L_{Aeq(15min)}$, dB(A)

NAG	Period [1]	PANL or Cumulative noise criteria
NAG 1	Day	48
	Evening	43
	Night	38
	Morning shoulder	43 [2]
NAG 2	Day	53
	Evening	46
	Night	43
	Morning shoulder	48 [2]
NAG 3	Day	53
	Evening	44
	Night	42
	Morning shoulder	48 [2]
R24 - Hunter Valley Paintball	When in use	53
R25 - Ringwood Park Motor Complex/Circuit Italia	When in use	68
R26 – Boral Quarry R27 – Eagleton Quarry	When in use	68

Notes: [1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of morning shoulder or day period. Shoulder period is 6:00 am-7:00 am Monday-Saturday and 7:00 am-8.00 am Sunday and Public Holidays.

[2] Whilst shoulder period PNTL in accordance with NPfI Section A3 is assigned based upon the intrusiveness noise level only, for cumulative noise criteria, it has been adopted as the midpoint between day and night period PANL.

3.2 Construction Noise Criteria

As described in **Section 1.1**, the Project will require construction activities, which will be undertaken within standard construction hours (7:00 am to 6:00 pm Monday to Friday, 8:00 am to 1:00 pm Saturday). Note, any upgrade of the Italia Rd and Pacific Highway intersection and associated construction works will be subject to a separate assessment process.

The EPA recognises that construction activities could potentially generate higher noise levels than those of an industrial operation. The ICNG provides noise management criteria for construction activities. The criteria are intended to guide the need for, and the selection of, feasible and reasonable work practices to minimise construction noise impacts.

The applicable construction noise assessment levels from Table 2 of the ICNG are summarised in **Table 3.8**.

Table 3.8 Noise assessment criteria (ICNG - Table 2)

Time of day	Noise Management Level (NML) $L_{Aeq,15minute}$
Recommended Standard Hours Monday to Friday - 7 am to 6 pm Saturday - 8am to 1pm No work on Sundays or Public Holidays	Noise affected Rating Background Level (RBL) + 10 dB
	Highly noise affected 75 dB(A)
Outside recommended standard hours	Noise affected RBL + 5 dB

The ICNG states that the RBL is described in the *Industrial Noise Policy* (INP) (EPA, 2000). However, the INP has been superseded by the NPfI which defines the RBL as:

> *"the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period … The rating background level is the level used for assessment purposes. Where the rating background level is found to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A); where it is found to be less than 35 dB(A) for the daytime period then it is set to 35 dB(A)."*

The construction noise goals for each defined receiver area are provided in **Table 3.9**. For information, criteria for outside recommended standard hours have been presented. The assessment of construction noise is discussed in **Section 5.0**.

Table 3.9 Construction Noise Management Levels for Residential Receivers

NAG	RBL Day/Evening/Night	Recommended Standard Hours [1]		Outside recommended standard hours
		RBL + 10	Highly noise affected	RBL + 5
NAG 1	35/31/30	45	75	36/35
NAG 2	50/49/39	60	75	54/44
NAG 3	50/49/42	60	75	54/47

Note: [1] Recommended Standard Hours: Monday to Friday 7.00 am - 6.00 pm; Saturday 8.00 am - 1.00 pm; No work on Sundays or Public Holidays.

The ICNG noise management levels for sensitive land uses (other than residences) are shown in **Table 3.10.**

Table 3.10 ICNG Noise Management Levels for Sensitive Land Uses (Other Than Residences)

Land use	Management level, $L_{Aeq(15min)}$ (applies when properties are being used)
Active recreation - Hunter Valley Paintball	External noise level 65 dB(A)
Industrial - Boral and Eagleton Quarries, Circuit Italia and Ringwood Motorsport Complex	External noise level 75 dB(A)

3.3 Road Traffic Noise Criteria

The RNP sets out criteria for road traffic noise through the provision of a framework that addresses traffic noise issues associated with new developments, new or upgraded road developments, or planned building developments.

The primary road haul route to and from the quarry will be via Italia Road and the Pacific Highway. No Project trucks will travel along Italia Road north of the site access point towards Seaham. **Table 3.11** outlines the operational and construction road traffic noise criteria for residential land uses along the primary road haul route. Under the road category definitions provided in the RNP, Italia Road and the Pacific Highway are respectively classified as a sub-arterial road and an arterial road.

Table 3.11 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project/Land Use	Assessment Criteria dB(A)	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/ sub-arterial road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	L_{Aeq}, (15 hour) 60 (external)	L_{Aeq}, (9 hour) 55 (external)

Section 3.4 of the RNP notes that where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

The EPA publication *Applying the NSW Road Noise Policy* states:

> *"…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 as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."*

In assessing noise impact, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

3.4 Voluntary Land Acquisition and Mitigation Policy Criteria

In September 2018, the NSW government published the revised *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (NSW Government, 2018) (VLAMP). This document describes the NSW Government's policy for voluntary mitigation and land acquisition to address noise impacts from state significant mining, petroleum and extractive industry developments.

In accordance with the SEARs the VLAMP applies to the Project. Where the noise impacts cannot achieve the PNTL, both the NPfI and VLAMP provide guidelines for the assessment of the residual noise impacts. It should be noted that the method of assessing residual noise impact differs slightly between the NPfI and the VLAMP. Both assessment tables are reproduced below as **Table 3.12** and **Table 3.13**.

A consent authority may apply voluntary mitigation rights where, even with the implementation of best practice management at the site:

- the noise impacts of the development would be characterised as marginal, moderate or significant (refer **Table 3.12** and **Table 3.13**) at any residence on privately owned land, or
- the development would increase the total industrial noise level at any residence on privately owned land by more than 1 dB(A) and noise levels at the residence are already above the recommended amenity noise levels in Table 2.2 of the Noise Policy for Industry.

A consent authority may apply voluntary acquisition rights where, even with the implementation of best practice management at the site:

- the noise impacts of the development would be characterised as significant (refer **Table 3.12** and **Table 3.13**) at any residence on privately owned land, or
- the noise generated by the development would contribute to exceedances of the acceptable noise levels plus 5 dB in Table 2.2 of the NPfI on more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Table 3.12 Significance of Residual Noise Impacts – NPfI

If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Then the significance of residual noise level is:
≤ 2 dB(A)	Not applicable	**Negligible**
≥ 3 but ≤ 5 dB(A)	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1dB	**Marginal**
≥ 3 but ≤ 5 dB(A)	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	**Moderate**
> 5 dB(A)	≤ recommended amenity noise level	**Moderate**
> 5 dB(A)	> recommended amenity noise level	**Significant**

Source: NPfI, Table 4.1 (EPA, 2017)

The NPfI notes that guidance contained in **Table 3.12** is designed for new and substantially-modified developments and should not be routinely applied to existing situations without proper consideration of the specific circumstances, that is, within the context of what is achievable and feasible. It is also noted that **Table 3.12** does not cover all permutations of the residual noise level when assessing the noise impacts from a modification to an existing development.

Table 3.13 Characterisation of Noise Impacts – VLAMP

If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Characterisation of impacts:	Potential treatment:
All time periods 0-2 dB(A)	Not applicable	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
All time periods 3-5 dB(A)	≤ recommended amenity noise levels in Table 2.2 of the NPfI; or > recommended amenity noise levels in Table 2.2 of the NPfI, but the increase in total cumulative industrial noise level resulting from the development is ≤ 1 dB	Impacts are considered to be **marginal**	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity
All time periods 3-5 dB(A)	> recommended amenity noise level in Table 2.2 of the NPfI, and the increase in total cumulative industrial noise level resulting from the development is > 1 dB	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded façade elements like windows, doors or roof insulation, to further increase the ability of the building façade to reduce noise levels
Day and evening >5 dB(A)	≤ recommended amenity noise levels in Table 2.2 of the NPfI	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded façade elements like windows, doors or roof insulation, to further increase the ability of the building façade to reduce noise levels
Day and evening >5 dB(A)	> recommended amenity noise levels in Table 2.2 of the NPfI	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions above
Night >5 dB(A)	Not applicable	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions above

Source: Table 1 of VLAMP, NSW Government 2018

3.5 Vibration

Due to the large separation distances between the Project Area and the nearest affected receivers (i.e. receiver 241 Italia Rd, located 315 m from the disturbance boundary), potential structural damage and human annoyance from vibration inducing operational and construction equipment/activities is anticipated to be negligible and is not addressed further in this NIA.

This NIA does not address potential noise and vibration impacts from blasting. A separate Blast Impact Assessment has been prepared to address potential blasting impacts, refer to the EIS.

4.0 Operational Noise Assessment

The noise impacts associated with the Project have been assessed by comparing predicted noise levels from the project operations against the noise assessment levels (see **Section 4.4)**, established in accordance with the applicable legislation, guidelines and policies.

4.1 Methodology

Noise levels were predicted using the CadnaA (Version 2021 MR 2) proprietary environmental noise modelling software package. The noise predictions using the CadnaA software were undertaken using the CONCAWE noise calculation methodology.

The CadnaA software is approved for use by the Department of Planning and Environment (DPE) and the Environmental Protection Authority (EPA). The software utilises terrain data, source and receptor locations and heights, source sound power levels (in octave or 1/3 octave frequency bands) and input meteorological conditions to predict noise levels. The CONCAWE prediction method accounts for the influence of noise propagation from atmospheric temperature, atmospheric relative humidity, wind speed, wind direction and Atmospheric Pasquill Stability Class (for defining the presence and strength of temperature inversions).

The noise prediction model considers:

- Location of noise sources and sensitive receiver locations.
- Heights of sources and receivers with reference to a 3-dimensional terrain surface based on LIDAR derived 1 m contour interval topography.
- Separation distances between sources and receivers.
- Ground type and reflections between sources and receivers.
- Geometric spreading and air absorption.
- Attenuation from earth bunds, buildings and structures (natural terrain and purpose built).
- The incorporated noise control measures (refer to **Section 4.2**).
- The quarry plans provided by the proponent, which include the number and type of machines and representative positioning based on each quarry plan (refer to **Section 4.3**).
- The noise source levels of individual plant and equipment (refer to **Section 4.3.2**).
- Atmospheric losses and the meteorological conditions (refer to **Section 4.3.3**).

4.2 Incorporated Noise Control Measures

ARDG has committed to a comprehensive suite of noise control measures to minimise noise emissions. The noise control measures have been incorporated into the modelling process.

Throughout the development of the conceptual quarry plan, consultation with the design team was undertaken to identify, design and optimise the operational and engineered noise controls that can be implemented. This process was undertaken to inform the operational constraints to the Project that may be required to meet noise criteria. This process resulted in the following design outcomes:

- The Processing Area (RL 43) cutting into the existing surface, to increase acoustic shielding to the nearest sensitive receivers.
- The initial relative height of the Northern Extraction Pit (RL 28) cutting into the existing surface, to increase acoustic shielding to the nearest sensitive receivers.
- The site entrance located as far as practicable from the nearest sensitive receivers.
- The sequence of extraction in 15 m bench heights, to always maintain a face between the nearest sensitive receivers and extraction area.

Operational noise control measures:

- During the morning shoulder period (6.00 am to 7.00 am) and evening period (6:00 pm to 10:00 pm), only loading and transport of road registered trucks and maintenance operations is to occur, i.e. no extraction, processing or VENM/ENM management activities will be undertaken.

Additionally, reasonable and feasible noise attenuation measures consistent with current best practice have been incorporated into the day-to-day operation of the Project. This includes equipment and internal road maintenance and the strategic placement of stockpiles up to 8 m high along the southern side of the processing area. For a conservative assessment, the stockpiles (and associated noise attenuation they may provide) have not been included in the modelling process.

4.3 Noise Model

4.3.1 Quarry Stages and Extraction Progression

The assessment has been undertaken by modelling a scenario representative of reasonable worst-case noise emissions from quarry operations during four stages: Stages 0, 1, 5 and 9. Noise predictions were undertaken for the day, morning shoulder and evening periods and incorporated the noise control and mitigation measures committed to by ARDG as described above in **Section 4.2**.

Descriptions and of the modelled scenarios for each stage are provided below. These stages were chosen as they had the greatest potential to cause impact and cover the progression of the life of operations (i.e. production progressively increasing as the extraction area expands and deepens). The modelled stages are consistent with the modelling undertaken as part of the Air Quality Assessment.

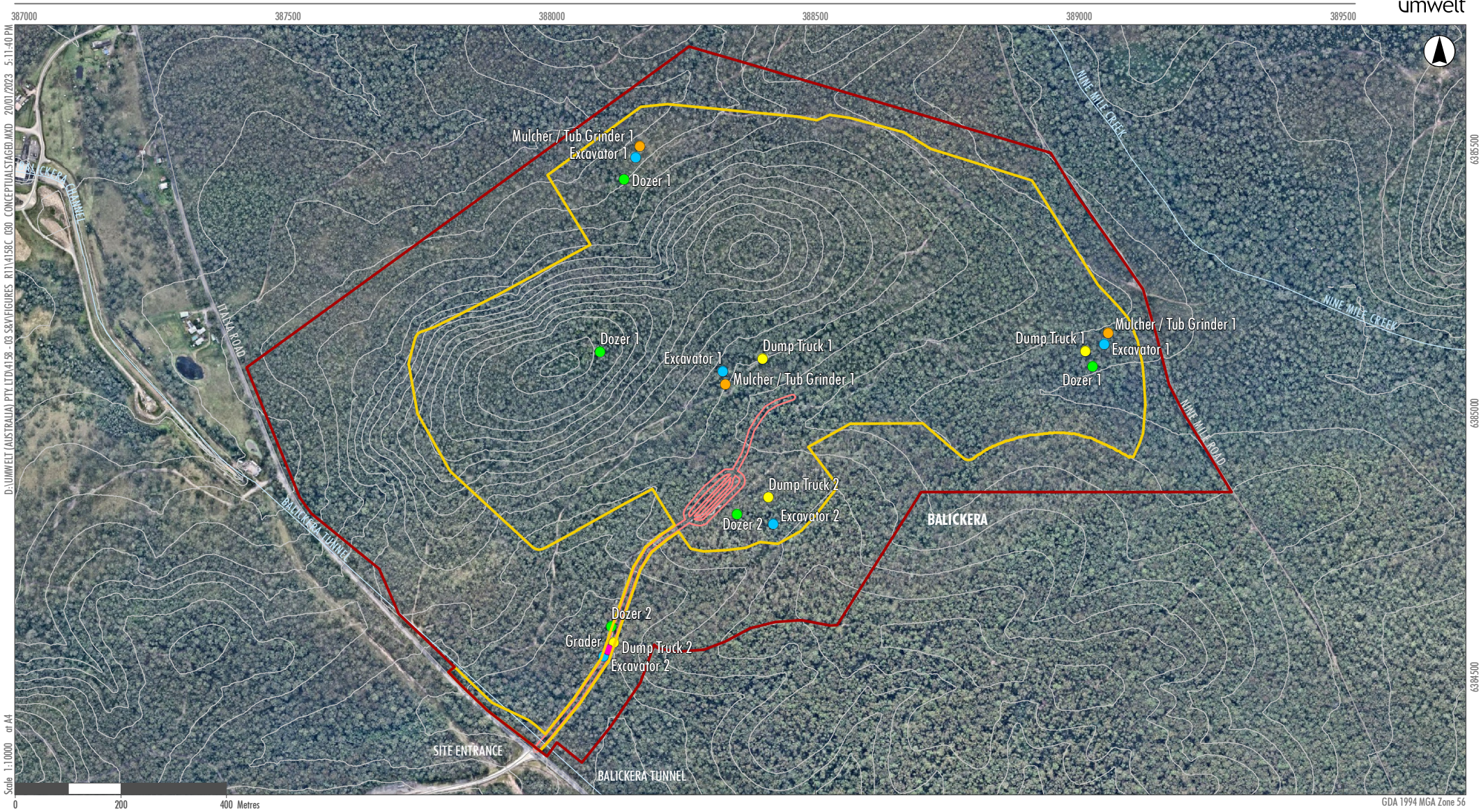
The conceptual quarry stage plans for Stages 0, 1, 5 and 9 are shown in **Figure 4.1** to **Figure 4.4** and represent indicative key features of the proposed progression of the extraction areas. The stages are briefly described below:

- **Stage 0 (Initial earthworks / stripping of overburden):** Pre-operations and site preparation /earthworks. Approximately 0.227M tonnes overburden removed.
- **Stage 1 (Until the end of Year 1):** Initial processing of quarry materials predominantly in the main pit area (94%), remainder in northern pit (6%). Approximately 1.68M tonnes processed in Stage.
- **Stage 5 (Until the end of Year 10):** Mid-life of operations (approximately Years 6 – 10 of operations). Approximately 5.58M tonnes process in Stage.
- **Stage 9 (Until the end of Year 30):** End of life of operations (approximately Years 25 – 30 of operations). Approximately 7.42M tonnes process in Stage.

4.3.2 Modelled Plant and Equipment

The sound power levels utilised in the noise modelling are based on data supplied by ARDG, measurements of similar plant by Umwelt, product specifications, estimated from noise source data in published literature or from published noise impact reports for similar projects. The sound power levels of equipment, the area where equipment is located, and the number of items modelled for each stage of the Project are provided in **Table 4.1**.

The locations of the proposed noise sources are shown in **Figure 4.1** to **Figure 4.4.**



Legend

- Project Area
- Disturbance Area
- Road
- Drainage Line
- Contour Line
- Access Road

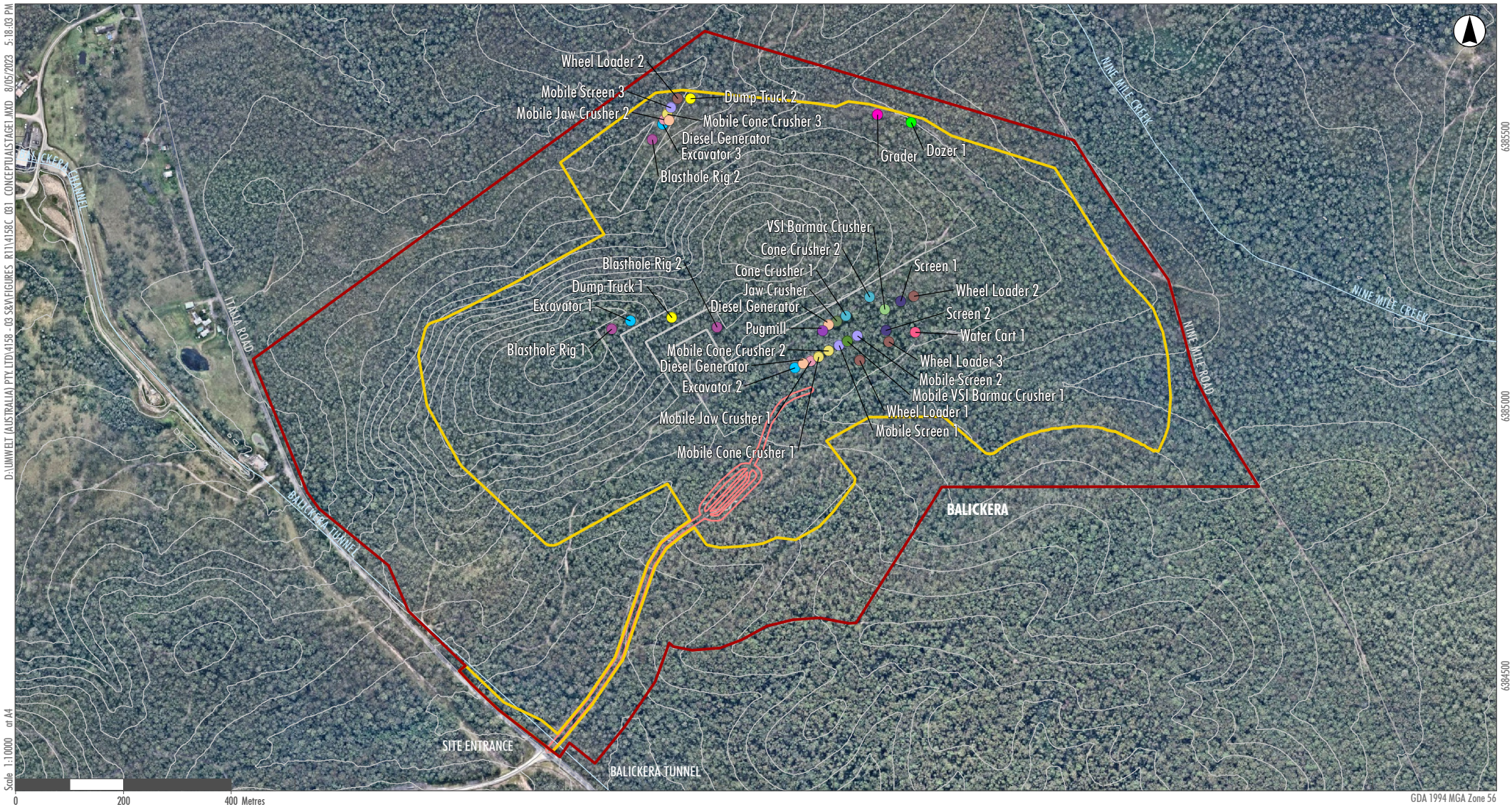
Equipment

- Dozer
- Dump Truck
- Excavator
- Grader
- Mulcher / Tub Grinder

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.1

Conceptual Quarry Plan Stage 0 - Equipment Location



Legend

- Project Area
- Disturbance Area
- Road
- Drainage Line
- Contour Line
- Access Road

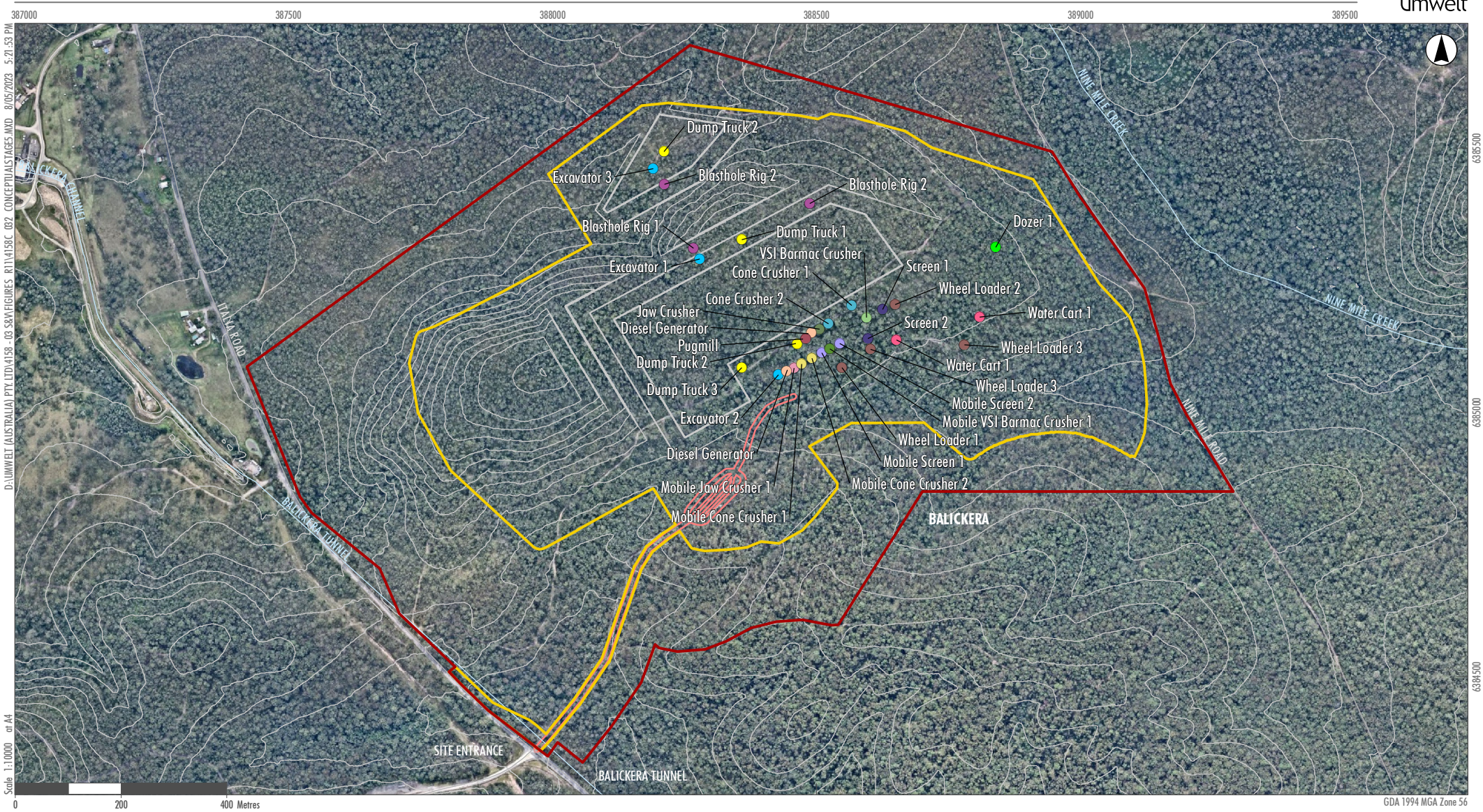
Equipment

- Blasthole Rig
- Cone Crusher
- Diesel Generator
- Dozer
- Dump Truck
- Excavator
- Grader
- Jaw Crusher
- Mobile Cone Crusher
- Mobile Jaw Crusher
- Mobile Screen
- Mobile VSI Barmac Crusher
- Pugmill
- Screen
- VSI Barmac Crusher
- Water Cart
- Wheel Loader

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.2

Conceptual Quarry Plan Stage 1 - Equipment Location



Legend

- Project Area
- Disturbance Area
- Road
- Drainage Line
- Contour Line

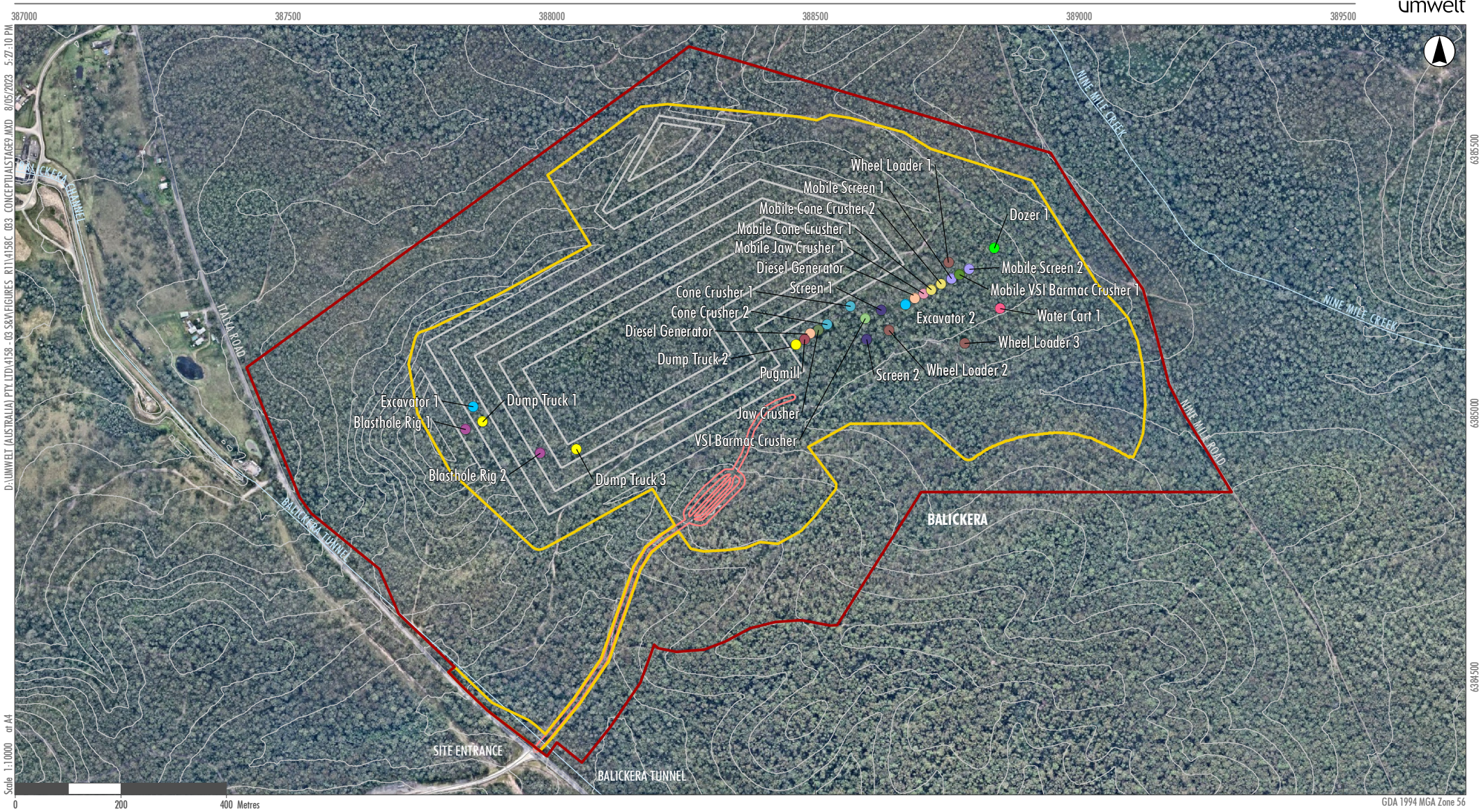
Equipment

- Blasthole Rig
- Cone Crusher
- Diesel Generator
- Dozer
- Dump Truck
- Excavator
- Jaw Crusher
- Mobile Cone Crusher
- Mobile Jaw Crusher
- Mobile Screen
- Mobile VSI Barmac Crusher
- Pugmill
- Screen
- VSI Barmac Crusher
- Water Cart
- Wheel Loader
- Access Road

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.3

Conceptual Quarry Plan Stage 5
- Equipment Location



Legend

- Project Area
- Disturbance Area
- Road
- Drainage Line
- Contour Line

Equipment

- Blasthole Rig
- Cone Crusher
- Diesel Generator
- Dozer
- Dump Truck
- Excavator
- Jaw Crusher
- Mobile Cone Crusher
- Mobile Jaw Crusher
- Mobile Screen
- Mobile VSI Barmac Crusher
- Pugmill
- Screen
- VSI Barmac Crusher
- Water Cart
- Wheel Loader
- Access Road

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.4

Conceptual Quarry Plan Stage 9 - Equipment Location

Table 4.1 Noise Source Sound Power Levels

Work Area	Item of Equipment	Stage and number of items					Sound Power Level (SWL)	
		Daytime [1]				Morning Shoulder & Evening Period [2]		
		Stage 0	Stage 1	Stage 5	Stage 9	Stage 1 - 9	Leq dB(A)	Leq dB(lin)
Surface	Dozer (CAT D10)	5	1	-	-	-	108	118
	Grader (CAT 140M)	1	1	-	-	-	113	117
	Excavator (KOMATSU 360LC)	2	-	-	-	-	104	109
	Excavator (KOMATSU 490LC)	3	-	-	-	-	106	111
	Dump Truck (KOMATSU HM400)	4	-	-	-	-	111	117
	Tub Grinder (VERMEER TG7000)	3	-	-	-	-	118	128
Northern Quarry Pit	Mobile Jaw Crusher (Metso Lokotrack LT120E)	-	1	-	-	-	121	128
	Mobile Cone Crusher (Metso Lokotrack LT300HP)	-	1	-	-	-	112	119
	Mobile Screen (Metso Four Deck Screen ST4.10)	-	1	-	-	-	116	123
	Dump Truck (KOMATSU HM400)	-	1	1	-	-	111	117
	Wheeled Loader (KOMATSU 600-6)	-	1	-	-	-	113	124
	Excavator (KOMATSU 360LC)	-	1	1	-	-	104	109
	Blasthole Rig (Epiroc T40)	-	1	1	-	-	115	119
	Generator (420kVA)	-	1	-	-	-	110	115
Processing Area	Jaw Crusher (Metso NW120)	-	1	1	1	-	121	128
	Cone Crusher (Metso NW300GP)	-	2	2	2	-	112	119
	VSI Crusher (Metso VSI Barmac NW9100)	-	1	1	1	-	129	137
	Screen (Metso Four Deck Screen NW1855D)	-	2	2	2	-	116	123
	Mobile Jaw Crusher (Metso Lokotrack LT120E)	-	1	1	1	-	121	128
	Mobile Cone Crusher (Metso Lokotrack LT300HP)	-	2	2	2	-	112	117

Work Area	Item of Equipment	Stage and number of items					Sound Power Level (SWL)	
		Daytime [1]				Morning Shoulder & Evening Period [2]		
		Stage 0	Stage 1	Stage 5	Stage 9	Stage 1 - 9	Leq dB(A)	Leq dB(lin)
	Mobile VSI Crusher (Metso Lokotrack VSI Barmac LT7150)	-	1	1	1	-	129	137
	Mobile Screen (Metso Four Deck Screen ST4.10)	-	2	2	2	-	116	123
	Pugmill	-	1	1	1	-	109	114
	Generator (420kVA)	-	2	2	2	-	110	115
	Excavator (KOMATSU 360LC)	-	1	1	1	-	104	109
	Wheeled Loader (KOMATSU 600-6)	-	3	3	2	1	113	124
	Dump Truck (KOMATSU HM400)	-	-	1	1	-	111	117
	Dump Truck (KOMATSU HD605-7EO)	-	-	1	-	-	116	123
	Water Cart	-	1	1	-	1	104	111
Stockpile	Dozer (CAT D10)	-	-	1	1	-	108	118
	Wheeled Loader (KOMATSU 600-6)	-	-	1	1	-	113	124
	Water Cart	-	-	1	1	-	104	111
Quarry Pit	Blasthole Rig (Epiroc T40)	-	2	2	2	-	115	119
	Excavator (KOMATSU 490LC)	-	1	1	1	-	106	111
	Dump Truck (KOMATSU HM400)	-	1	1	1	-	111	117
	Dump Truck (KOMATSU HD605-7EO)	-	-	-	1	-	116	123
Haul Road	Product Trucks (uphill unloaded)	-	30 p/hr	30 p/hr	30 p/hr	30 p/hr	113	119
	Product Trucks (downhill loaded)						108	117

Notes: Screening and crushing plant source height is 4m above local ground level. Source height of all other sources is 2m above local ground level.

[1] Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays.

[2] Morning shoulder period is 6:00 am - 7:00 am Monday to Saturday and evening period is 6.00 pm-10.00 pm

The equipment listed in **Table 4.1** may change during the life of the project to meet operational demands and reflect changes in technology. Notwithstanding this, all key items of plant and equipment will incorporate reasonable and feasible noise control measures. The level of equipment attenuation, as indicated by the SWL's presented in **Table 4.1**, are considered indicative rather than mandatory. The actual performance of the project as a whole will be determined by monitoring the environmental noise levels over the life of the project and will dictate equipment selection criteria.

It is noted that during the morning shoulder period (6.00 am to 7.00 am) and the evening period (6:00 pm to 10:00 pm), the only operations on the quarry are those associated with the loading and transport of road registered trucks and maintenance operations, i.e. there is no extraction, processing or VENM/ENM management activities undertaken.

4.3.3 Meteorological Conditions

Certain meteorological conditions may increase noise levels by focusing soundwave propagation paths at a single point. Such refraction of sound waves will occur during temperature inversions (i.e. atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient (i.e. wind velocities increasing with height above ground level) and there is a supporting wind from the source to the receiver.

The NPfI approach to account for noise-enhancing weather conditions is to state the meteorological conditions under which the PNTLs and limits will apply, rather than stipulating the noise modelling parameters that must be used. Standard meteorological conditions and noise-enhancing meteorological conditions have been defined in Table D1 of the NPfI (reproduced in **Table 4.2**).

Table 4.2 Standard and Noise-enhancing Meteorological Conditions

Meteorological conditions	Meteorological parameters [1]
Standard meteorological conditions	Day/Evening/Night: Stability categories A to D with wind speed up to 0.5 m/s at 10 m above ground level.
Noise-enhancing meteorological conditions	Day/evening: Stability categories A to D with light winds (up to 3 m/s at 10 m above ground level) Night: Stability categories A to D with light winds (up to 3 m/s at 10 m above ground level) and/or stability category F with winds up to 2 m/s at 10 m above ground level.

Notes: [1] Where a range of conditions is nominated, the meteorological condition delivering the highest predicted noise level should be adopted for assessment purposes. However, feasible and reasonable noise limits in consents and licences derived from the process would apply under the full range of meteorological conditions nominated under standard or noise-enhancing conditions as relevant.

The NPfI provides two options for the assessment of meteorological effects:

1. Adopt the **noise-enhancing meteorological conditions** for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all receivers and F class temperature inversions with wind speeds up to 2 m/s at night.

2. Determine the **significance of noise-enhancing conditions**. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30% determined in accordance with the NPfI provisions. Where noise-enhancing meteorological conditions occur for less than 30% of the time, standard meteorological conditions may be adopted for the assessment.

In this NIA Option 2 was used. The analysis of the meteorological data is provided in **Appendix C**.

In summary the analysis concluded that noise-enhancing meteorological conditions are a significant feature of the area. Wind speeds up to 3 m/s generally from the WNW were found to occur for more than 30 % of the time during the night-time period. Atmospheric stability class condition "F" was found to occur for more than 30% of the evening and night-time period during the winter months.

In accordance with the NPfI, the noise assessment has been undertaken by incorporating these meteorological conditions into the noise predictions. Additionally, noise predictions have also been undertaken assuming standard meteorological conditions (i.e. calm winds, atmospheric stability class "D") during the day, evening and night-time period, to include the possible case where this meteorological condition may constitute the worst-case condition at some receivers.

4.4 Results

4.4.1 Daytime

The predicted noise level at each receiver is shown in **Table 4.3** for each of the four (4) modelled operating stages described in **Section 4.0** under standard meteorological conditions. The operational noise levels are predicted to comply with the daytime PNTLs at all sensitive receivers.

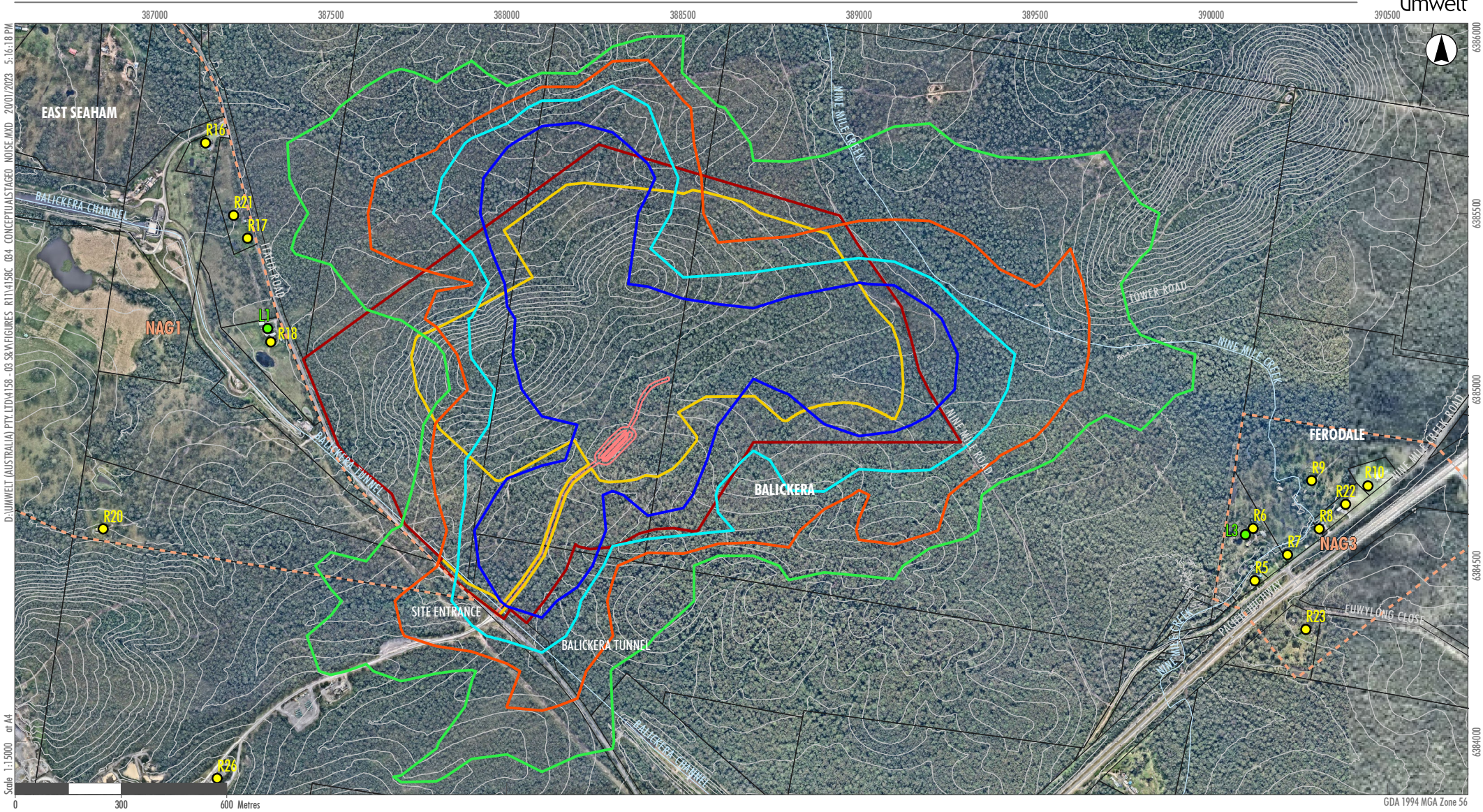
Noise contours for each stage under standard meteorological conditions are presented in **Figure 4.5** to **Figure 4.8**.

Table 4.3 Predicted Daytime Noise Levels for Stages 0 to 9, dB(A)

ID	Address / Description	NAG	Daytime PNTL	Noise Prediction, $L_{Aeq(15min)}$ [1]			
				Standard Conditions			
				Stage			
				0	1	5	9
R1	16 Italia Rd	NAG_2	53	24	31	31	30
R5	1 Nine Mile Creek Rd	NAG_3	53	29	40	40	41
R6	5 Nine Mile Creek Rd	NAG_3	53	31	40	40	42
R7	17 Nine Mile Creek Rd	NAG_3	53	29	39	39	40
R8	9 Nine Mile Creek Rd	NAG_3	53	30	39	39	42
R9	17 Nine Mile Creek Rd	NAG_3	53	35	44	41	45
R10	13 Nine Mile Creek Rd	NAG_3	53	33	43	43	45
R11	393 Italia Rd	NAG_1	40	23	28	24	30
R12	379 Italia Rd	NAG_1	40	26	30	26	31

ID	Address / Description	NAG	Daytime PNTL	Noise Prediction, $L_{Aeq(15min)}$ [1]			
				Standard Conditions			
				Stage			
R13	373 Italia Rd	NAG_1	40	26	31	28	33
R14	361 Italia Rd	NAG_1	40	32	36	29	33
R15	343 Italia Rd	NAG_1	40	29	34	29	33
R16	299 Italia Rd	NAG_1	40	33	38	33	37
R17	267 Italia Rd	NAG_1	40	33	39	33	37
R18	241 Italia Rd	NAG_1	40	34	39	31	34
R19	303 Italia Rd	NAG_1	40	31	32	24	31
R20	209B Italia Rd	NAG_1	40	24	30	26	27
R21	267 Italia Rd	NAG_1	40	34	39	34	38
R22	9 Nine Mile Creek Rd	NAG_3	53	31	40	40	44
R23	7 Euwylong Close	NAG_3	53	30	44	44	45
R24	Hunter Valley Paintball	-	53	<20	27	27	26
R25	Circuit Italia	-	63	28	36	36	35
R26	Boral Quarry	-	68	35	45	44	44
R27	Eagleton Quarry	-	68	<20	29	29	28

Note: [1] Predictions below 20dB(A) have been presented as <20



Legend

- Project Area
- Disturbance Area
- Noise Monitor Locations
- Sensitive Receivers
- Noise Assessment Groups
- Pacific Highway
- Road
- Drainage Line
- Lots
- Contour Line
- Access Road

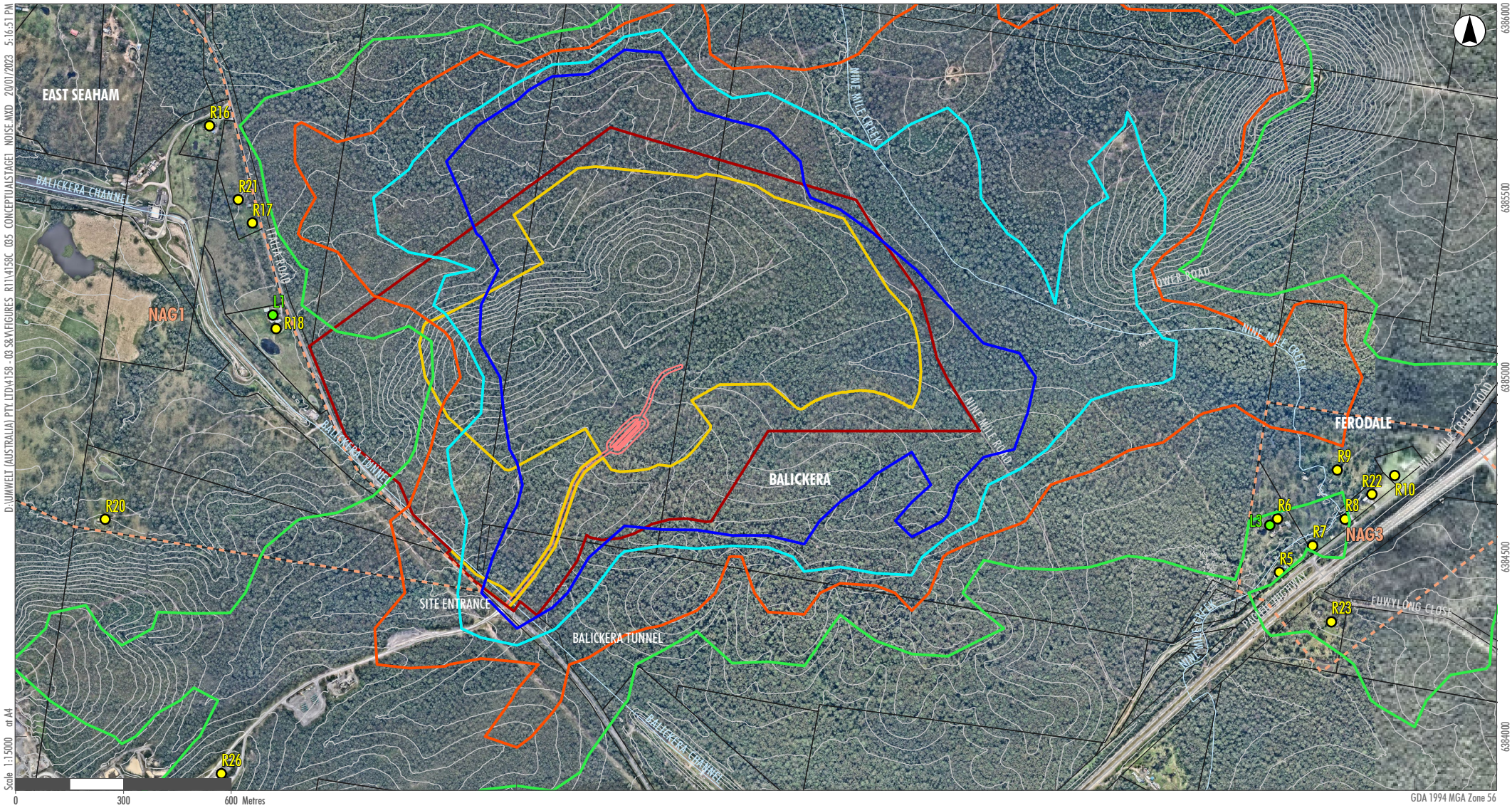
Predicted Noise Levels

- Noise Contour Level 40 dB(A)
- Noise Contour Level 45 dB(A)
- Noise Contour Level 50 dB(A)
- Noise Contour Level 55 dB(A)

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.5

Conceptual Quarry Plan Stage 0 - Daytime Predicted Operational Noise Levels Under Standard Meteorological Conditions, LAeq(15 min) dB(A)



Legend

- Project Area
- Disturbance Area
- Noise Monitor Locations
- Sensitive Receivers
- Noise Assessment Groups
- Pacific Highway
- Road
- Drainage Line
- Lots
- Contour Line
- Access Road

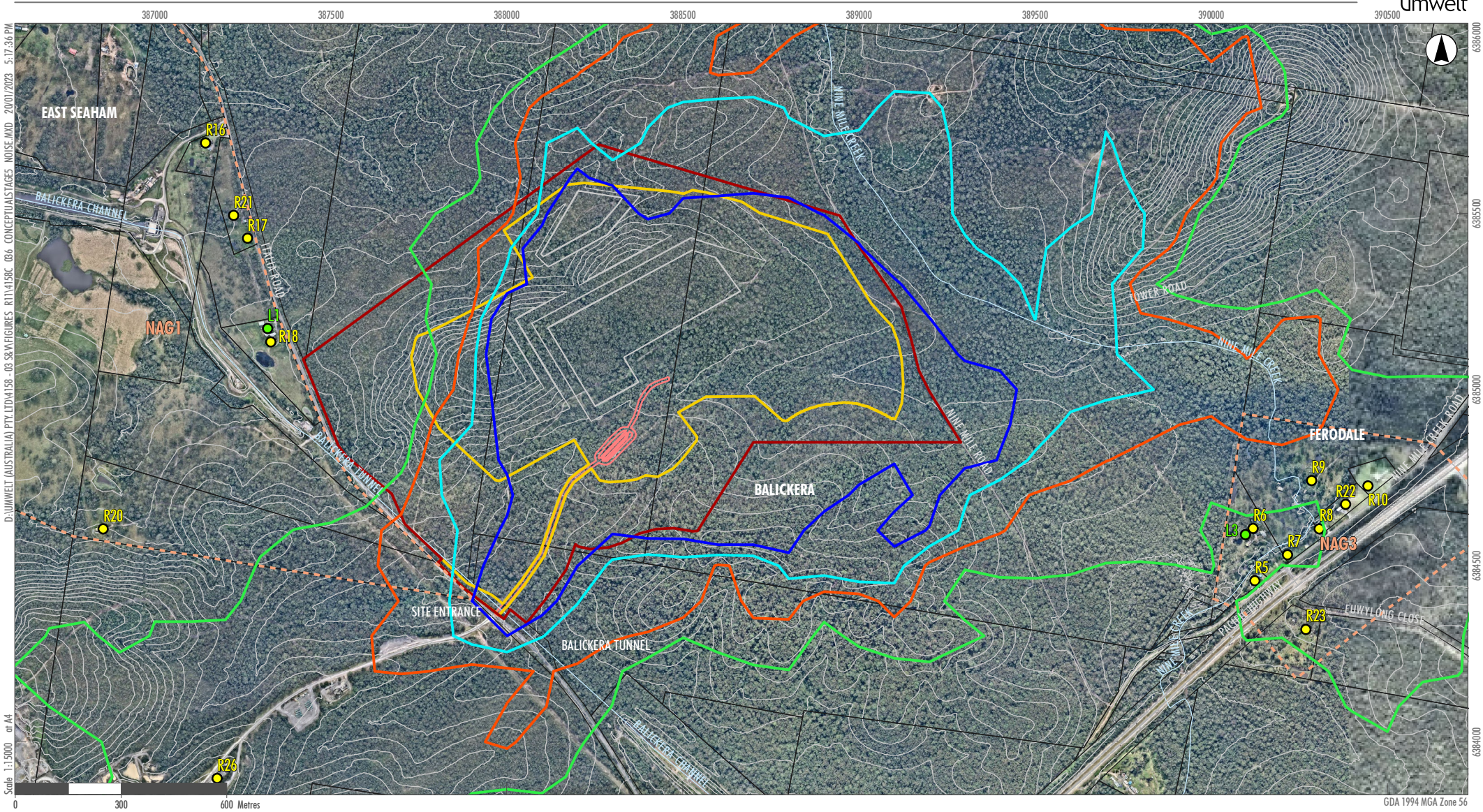
Predicted Noise Levels

- Noise Contour Level 40 dB(A)
- Noise Contour Level 45 dB(A)
- Noise Contour Level 50 dB(A)
- Noise Contour Level 55 dB(A)

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.6

Conceptual Quarry Plan Stage 1 - Daytime Predicted Operational Noise Levels Under Standard Meteorological Conditions, LAeq(15 min) dB(A)



Legend

- Project Area
- Disturbance Area
- Noise Monitor Locations
- Sensitive Receivers
- Noise Assessment Groups
- Pacific Highway
- Road
- Drainage Line
- Lots
- Contour Line
- Access Road

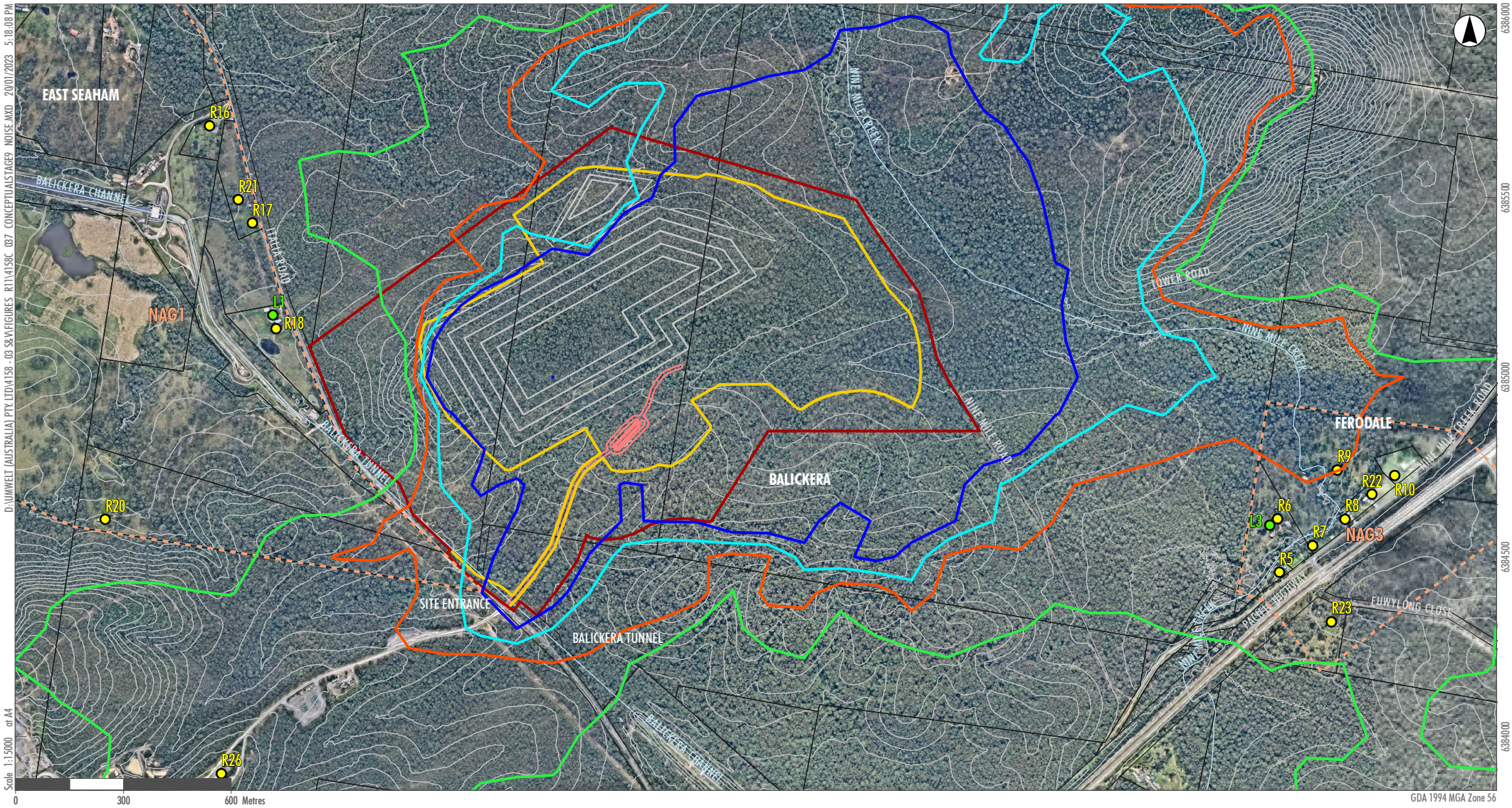
Predicted Noise Levels

- Noise Contour Level 40 dB(A)
- Noise Contour Level 45 dB(A)
- Noise Contour Level 50 dB(A)
- Noise Contour Level 55 dB(A)

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.7

Conceptual Quarry Plan Stage 5 - Daytime Predicted Operational Noise Levels Under Standard Meteorological Conditions, LAeq(15 min) dB(A)



Legend

- Project Area
- Disturbance Area
- Noise Monitor Locations
- Sensitive Receivers
- Noise Assessment Groups
- Pacific Highway
- Road
- Drainage Line
- Lots
- Contour Line
- Access Road

Predicted Noise Levels

- Noise Contour Level 40 dB(A)
- Noise Contour Level 45 dB(A)
- Noise Contour Level 50 dB(A)
- Noise Contour Level 55 dB(A)

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

FIGURE 4.8

Conceptual Quarry Plan Stage 9 - Daytime Predicted Operational Noise Levels Under Standard Meteorological Conditions, LAeq(15 min) dB(A)

4.4.2 Morning Shoulder and Evening Period

For Stages 1 to 9, the Project includes the loading and transport of up to 30 road registered trucks per hour, during the morning shoulder period (6.00 am to 7.00 am) and evening period (6:00 pm and 10:00 pm).

The predicted noise levels at each receiver are presented in **Table 4.4** under standard and noise-enhancing meteorological conditions. The operational noise levels are predicted to comply with the morning shoulder and evening PNTLs at all sensitive receivers.

Table 4.4 Predicted Morning Shoulder and Evening Noise Levels for Stages 0 to 9, dB(A)

ID	Address / Description	NAG	PNTL		Noise Prediction, $L_{Aeq(15min)}$ [1]					
					Standard Conditions			Enhancing Conditions		
					Stage			Stage		
			MS	E	1	5	9	1	5	9
R1	16 Italia Rd	NAG_2	47	46	<20	<20	<20	23	23	22
R5	1 Nine Mile Creek Rd	NAG_3	47	44	20	20	21	26	26	26
R6	5 Nine Mile Creek Rd	NAG_3	47	44	20	20	21	26	26	27
R7	17 Nine Mile Creek Rd	NAG_3	47	44	<20	<20	20	25	25	26
R8	9 Nine Mile Creek Rd	NAG_3	47	44	<20	<20	21	25	25	26
R9	17 Nine Mile Creek Rd	NAG_3	47	44	21	21	23	27	27	28
R10	13 Nine Mile Creek Rd	NAG_3	47	44	21	21	24	26	26	30
R11	393 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	<20
R12	379 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	<20
R13	373 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	20
R14	361 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	20
R15	343 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	20
R16	299 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	24
R17	267 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	22
R18	241 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	22
R19	303 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	<20
R20	209B Italia Rd	NAG_1	40	36	<20	<20	<20	20	20	20
R21	267 Italia Rd	NAG_1	40	36	<20	<20	<20	<20	<20	23
R22	9 Nine Mile Creek Rd	NAG_3	47	44	20	20	21	26	26	27
R23	7 Euwylong Close	NAG_3	47	44	21	21	25	27	27	31
R24	Hunter Valley Paintball	-	53	53	<20	<20	<20	<20	<20	<20
R25	Circuit Italia	-	63	63	22	22	22	27	27	27
R26	Boral Quarry	-	68	68	29	29	29	35	35	35
R27	Eagleton Quarry	-	68	68	<20	<20	<20	<20	<20	<20

Note: [1] Predictions below 20dB(A) have been presented as <20

4.4.3 Maximum Noise Event (Sleep Disturbance)

The quarry is not proposed to operate during the night-time, so potential sleep disturbance impacts are only relevant to the morning shoulder period. Noise sources that could lead to sleep disturbance are typically transient noise. No rock excavation or processing activities will occur during the morning shoulder period.

In regard to the $L_{Aeq,15minute}$ sleep disturbance assessment, as shown in **Table 4.4** the predicted noise levels are not higher than the sleep disturbance $L_{Aeq,15minute}$ criteria of 40 dB (NAG_1) and 47dB (NAG_2 & NAG_3) at all receivers.

In regard to the L_{Amax} sleep disturbance assessment, CandaA was used to determine noise levels from sleep disturbance events at the nearest sensitive residential receiver locations under standard and noise-enhancing meteorological conditions. The Project specific activities that have the potential for sleep disturbance include:

- Loading of product trucks using front end loader (L_{Amax} 126dB(A)) at the Processing Area.
- Product truck air brake release and acceleration (L_{Amax} 116dB(A)) at the Processing Area, the weighbridge and at the site entrance when leaving site.

Based on the above, the maximum noise level at all the receivers was predicted to be L_{Amax} 37dB(A) at receiver R9, which is significantly less than sleep disturbance L_{Amax} criteria of 52 dB (NAG_1) and 57 dB (NAG_2 & NAG_3). Accordingly, the Project is predicted to comply with the sleep disturbance criteria at all receivers.

4.4.4 Cumulative Noise Levels

Based on the noise levels within **Table 4.3** and **Table 4.4** no exceedances of the cumulative noise criteria, established in **Table 3.7**, are predicted.

4.4.5 VLAMP

Based on the noise levels within **Table 4.3** and **Table 4.4** operational noise levels are predicted to comply with the established PNTLs at all sensitive receivers. Accordingly, the VLAMP guidance is not considered applicable for the Project. Furthermore, the assessment has found that the Project would not:

- Increase the total industrial noise level at any residence on privately owned land by more than 1 dB(A) and noise levels at the residence are already above the recommended amenity noise levels in Table 2.2 of the Noise Policy for Industry.
- Contribute to exceedances of the acceptable noise levels plus 5 dB in Table 2.2 of the NPfI on more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

4.4.6 Corrections for Annoying Noise Characteristics

Fact Sheet C of the Noise Policy for Industry (NPfI) (EPA 2017) notes that noise sources containing characteristics such as tonality, impulsiveness, intermittency, irregularity or dominant low frequencies can cause greater annoyance than other noise at the same noise level.

Where the noise source contains annoying characteristics, the NPfI outlines the correction factors that should be applied to the noise from the source measured or predicted at the receiver before comparison with the Project Noise Trigger Level (PNTL).

The modifying factors that are potentially relevant to the assessment of the Project are:

- Tonal noises with a prominent frequency determined according to the following criteria:
    - 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 above 400 Hz;
        - 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive;
        - 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.
- Low frequency determined according to the following criteria:
    - Compare the predicted dB(A) and dB(C), if the difference is 15 dB or more and
        - If the low-frequency threshold (NPfI Table C2) is exceeded by up to 5 dB and cannot be mitigated, a 2 dB penalty is applicable during the evening and night-time.
        - If the low-frequency threshold (NPfI Table C2) is exceeded by more than 5 dB and cannot be mitigated, a 5 dB penalty is applicable during the evening and night-time or a 2 dB penalty during the daytime.
- Intermittent noise applied to night-time only:
    - Subjectively assessed where the noise level varies by more than 5 dB.
- Duration:
    - Measured as a single-event noise where the duration may range from 1.5 minutes to 2.5 hours over any 24-hour period.

The NPfI states that the modifying factors are to be applied to the noise from the source measured or predicted at the receiver before comparison with the criteria. Where two or more modifying factors are present, the maximum correction is limited to 10 dB. However, the NPfI also notes that 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.

4.4.6.1 Tonal

The assessment for the Project was prepared on the basis that equipment generating noise is well maintained. Failure to replace damaged mufflers, acoustic louvres and associated attenuation equipment could result in the generation of unacceptable tonal or low-frequency noises. The noise sources that have been adopted for this noise assessment are assumed to be non-tonal. In the event that noise emissions from the Project at the nearby sensitive receivers indicate that a penalty for tonality is applicable and the noise levels are non-compliant, then noise management and control strategies will be investigated to reduce the emissions from the Project to achieve compliance with the noise limits. This may include alternative equipment, additional noise controls, machinery redesign, enclosures, localised barriers, or restricted operating times, or by the Project applying active noise control.

4.4.6.2 Low Frequency Noise

To assess for low-frequency penalties, a low-frequency noise assessment has been undertaken for:

- The maximum predicted operational noise levels for day period (under standard met conditions), at receivers which may result in an exceedance of the PTNL if a low-frequency penalty (2 dB(A)) was applied (i.e., PTNL minus 2 dB(A)).
- The maximum predicted operational noise levels for evening and night (under noise enhancing met conditions), at receivers which may result in an exceedance of the PTNL if a low-frequency penalty (5dB(A)) was applied (i.e., PTNL minus 5 dB(A)).

The predicted noise levels at receivers which would remain below the PTNL if a maximum low-frequency noise penalty (2dB(A) for day period and 5 dB(A) for evening and night periods) was applied have been excluded from this assessment

As shown in **Table 4.5** a low-frequency penalty is not applicable as there is not a difference of 15 dB or more between the predicted C and A-weighted noise levels.

Table 4.5 Difference Between Predicted C and A-Weighted Noise levels for Operational Noise

Receiver	Predicted C Weighted Noise Level	Predicted A Weighted Noise Level	Difference Between the Predicted C and A Weighted Noise Levels	Low-Frequency Penalty Applicable (Y/N?)
R16 - 299 Italia Rd	52	38	13	N
R17 - 267 Italia Rd	53	39	14	N
R18 - 241 Italia Rd	53	39	14	N
R21 - 267 Italia Rd	53	39	14	N

4.4.6.3 Summary

Based on this analysis, it is considered that the application of modifying factors for tonality and low-frequency noise emissions is not necessary provided that there is an appropriate level of maintenance and management of the mobile machinery used at the Quarry.

5.0 Construction Noise Assessment

The noise impacts associated with the Project have been assessed by comparing predicted noise levels from project construction activities against the construction noise management established in accordance with the ICNG.

5.1 Methodology

Noise levels were predicted using the CadnaA (Version 2021 MR 2) proprietary environmental noise modelling software package. The noise predictions using the CadnaA software were undertaken using the CONCAWE noise calculation methodology.

The prediction of construction noise levels takes into account the noise sources that may reasonably be expected to be in use during the construction activities (refer to **Section 5.3**).

The nearest sensitive receivers potentially impacted by construction noise are identified in **Section 1.4.**

5.2 Construction Activities

The construction stages will broadly include the following:

1. Italia Road Site Entrance / Intersection
2. Site Access Road - Italia Rd to Weighbridge Area
3. Office / Weighbridge Pad and Assembly of Buildings
4. Site Access Road – Weighbridge Area to Pit
5. Stockpile Area
6. Northern Haul Road
7. Initial Stage 1 Pit Stripping.

It is likely that some of these stages may occur simultaneously through the progression of the construction program. To address the potential overlap of construction activities an additional scenario has been modelled based on all construction stages occurring simultaneously.

As described in **Section 1.1**, construction activities will be undertaken within standard construction hours (7:00 am to 6:00 pm Monday to Friday, 8:00 am to 1:00 pm Saturday).

Some works maybe required to be conducted outside of standard construction hours but within the proposed operational hours. Any works undertaken outside standard construction hours will be managed to comply with operational noise criteria set for the project. The upgrade of the Italia Rd and Pacific Highway intersection and associated construction works will be subject to a separate assessment process and noise impacts associated with these constructions activities has not been assessed as part of the is assessment.

5.3 Construction Equipment and Noise Levels

The typical construction activities, equipment and associated sound power levels (SWLs) of equipment are outlined in **Table 5.1**. Typical sound power levels have been sourced from the Roads and Maritime Construction Noise Estimator Tool and Umwelts noise source library.

Table 5.1 Construction Scenarios, Equipment and Sound Power Levels

Equipment	Construction Scenario / Stage & Number of Items							Sound Power Levels $L_{Aeq(15\ min)}$ dB(A)/ unit
	Sc 1	Sc 2	Sc 3	Sc 4	Sc 5	Sc 6	Sc 7	
Dozer 50T	-	1	1	1	1	1	1	108
Dozer 23T	1	1	1	1	-	1	-	107
Grader	1	1	1	1	1	1	1	113
Roller / compactor 12T	2	2	2	2	1	1	-	110
Dump truck/s 40T	-	3	3	3	3	3	3	111
Excavator 70T	-	1	1	1	1	1	1	107
Excavator 35T	1	-	-	1	1	1	-	104
Excavator 15T	1	1	1	1	-	-	-	103
Water cart	1	1	1	1	1	1	1	104
Tub grinder / mulcher	1	1	1	1	1	1	1	118
Roller 9T	1	1	1	-	-	-	-	109
Asphalt Paver	1	1	1	-	-	-	-	112
Truck and Dog	2	2	1	-	-	-	-	108
Tipper	3	2	1	-	-	-	-	106
Hand tools	-	-	5	-	-	-	-	107
Staff light vehicles	Up to 15							89

5.4 Results

Construction noise levels under standard meteorological conditions have been predicted for each of the seven construction scenarios/stages described in **Section 5.2** and **Table 5.1**. The predictions are conservative and assume all equipment associated with each scenario/stage is operating simultaneously and equipment is spread throughout the specific works area. In reality, a receiver would experience a range of construction noise levels, dependent upon the number of plant items operating at any one time and their precise location on site.

An additional worst-case construction scenario (Scenario 8) has been modelled based on all construction stages occurring concurrently. Whilst some aspects of each stage may occur simultaneously through the progression of the construction program, this scenario is considered very conservative and is unlikely to occur. However, this scenario has been modelled to demonstrate that the construction noise criteria can be readily achieved for the Project.

Results for each construction scenario (Sc.1 to Sc.8) for the identified receivers are presented in **Table 5.2**. The construction noise levels are predicted to comply with the daytime (Standard Hours) noise management level at all sensitive receivers. The predicted noise level contours for the worst-case scenario (Scenario 8) are presented graphically in **Figure 5.1**.

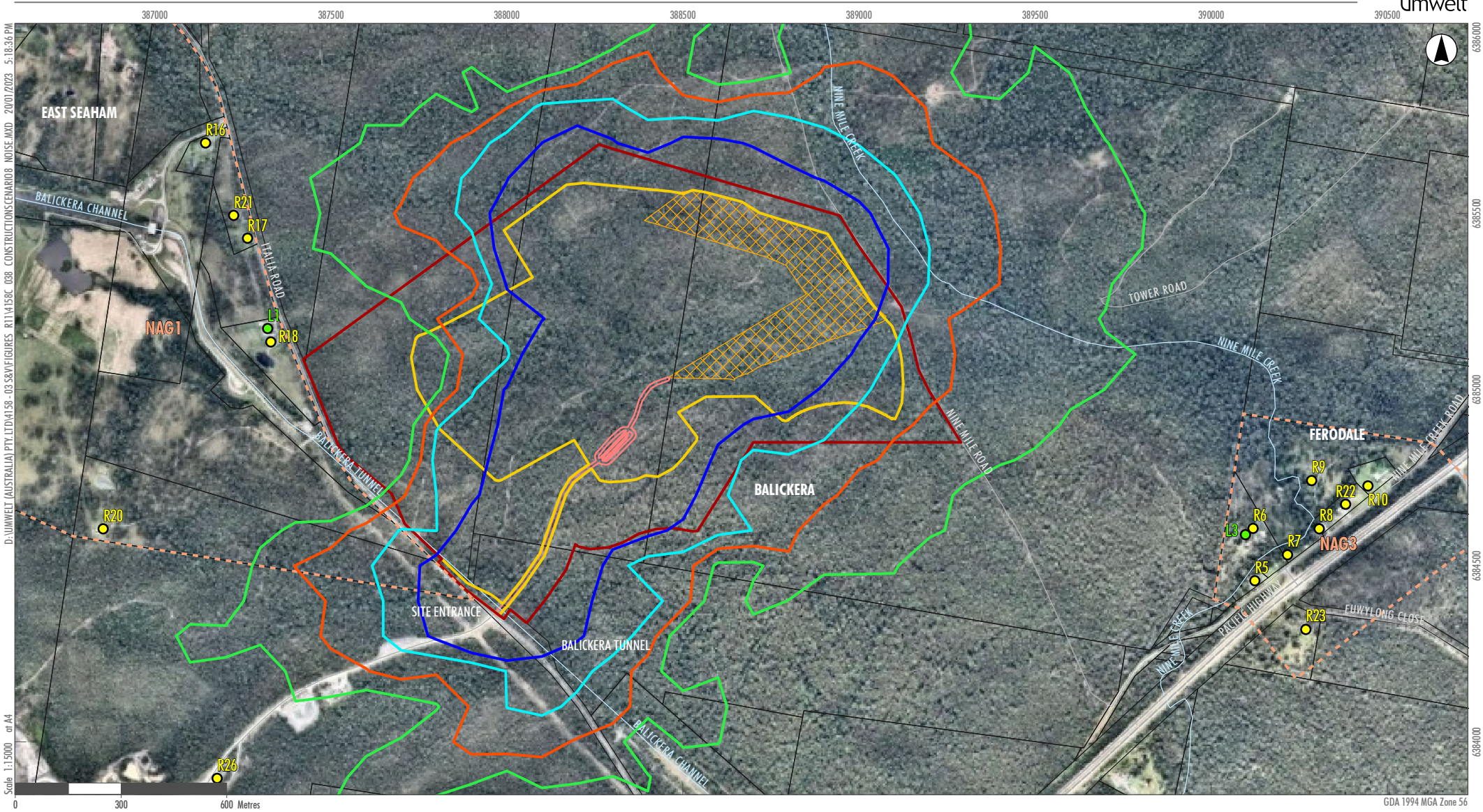
The construction noise levels are predicted to comply with the daytime noise management level at all sensitive receivers. It is also noted that the predicted construction noise impacts under the worst case Scenario 8 would also meet the operational PNTLs at all receivers. As the bulk of construction activities will be undertaken prior to the commencement of operations, it is unlikely that there would be a cumulative impact between operational and worst case construction activities. Nevertheless, reasonable and feasible noise mitigation and management strategies have been provided in **Section 7.2**. Whilst it is not essential to adopt these measures, in accordance with the ICNG, it is considered best practice to minimise construction noise as much as possible.

Table 5.2 Predicted Daytime Construction Noise Levels, dB(A)

ID	Address / Description	NAG	Noise Mgmnt Level, $L_{Aeq(15\ min)}$	Construction Scenario Noise Prediction, $L_{Aeq(15\ min)}$ [1]							
			Standard Hrs	1	2	3	4	5	6	7	8
R1	16 Italia Rd	NAG_2	60	26	25	25	20	<20	<20	23	32
R5	1 Nine Mile Creek Rd	NAG_3	60	<20	<20	24	24	30	25	31	35
R6	5 Nine Mile Creek Rd	NAG_3	60	<20	<20	27	26	31	27	30	36
R7	17 Nine Mile Creek Rd	NAG_3	60	<20	<20	25	25	30	26	27	34
R8	9 Nine Mile Creek Rd	NAG_3	60	<20	<20	26	25	30	26	28	35
R9	17 Nine Mile Creek Rd	NAG_3	60	<20	<20	27	26	36	31	30	38
R10	13 Nine Mile Creek Rd	NAG_3	60	<20	<20	26	25	34	30	29	37
R11	393 Italia Rd	NAG_1	45	<20	<20	<20	<20	<20	20	25	27
R12	379 Italia Rd	NAG_1	45	<20	<20	<20	<20	<20	23	27	29
R13	373 Italia Rd	NAG_1	45	<20	<20	<20	<20	<20	25	28	30
R14	361 Italia Rd	NAG_1	45	<20	<20	<20	<20	21	27	33	34
R15	343 Italia Rd	NAG_1	45	<20	<20	<20	<20	21	27	31	33
R16	299 Italia Rd	NAG_1	45	<20	<20	<20	<20	21	31	36	37
R17	267 Italia Rd	NAG_1	45	22	<20	<20	<20	20	31	35	37
R18	241 Italia Rd	NAG_1	45	26	23	20	<20	<20	30	36	37
R19	303 Italia Rd	NAG_1	45	21	20	<20	<20	<20	28	32	34
R20	209B Italia Rd	NAG_1	45	22	22	24	<20	<20	<20	24	30
R21	267 Italia Rd	NAG_1	45	21	<20	<20	<20	20	31	36	38
R22	9 Nine Mile Creek Rd	NAG_3	60	<20	<20	26	26	32	28	29	36
R23	7 Euwylong Close	NAG_3	60	<20	<20	25	25	34	28	29	37
R24	Hunter Valley Paintball	-	65	<20	<20	<20	<20	<20	<20	<20	24
R25	Circuit Italia	-	70	32	31	29	24	21	<20	26	36

ID	Address / Description	NAG	Noise Mgmnt Level, $L_{Aeq(15\ min)}$	Construction Scenario Noise Prediction, $L_{Aeq(15\ min)}$ [1]							
			Standard Hrs	1	2	3	4	5	6	7	8
R26	Boral Quarry	-	75	36	39	37	27	24	<20	31	43
R27	Eagleton Quarry	-	75	<20	20	20	<20	<20	<20	<20	26

Note: [1] Predictions below 20dB(A) have been presented as <20



Legend

- Project Area
- Disturbance Area
- Noise Monitor Locations
- Sensitive Receivers
- Noise Assessment Groups
- Pacific Highway
- Road
- Drainage Line
- Lots
- Access Road
- Stockpile and Plant Area

Predicted Noise Levels

- Noise Contour Level 45 dB(A)
- Noise Contour Level 50 dB(A)
- Noise Contour Level 55 dB(A)
- Noise Contour Level 60 dB(A)

FIGURE 5.1

Construction Scenario 8 Predicted Noise Levels Under Standard Meteorological Conditions, LAeq(15 min) dB(A)

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

6.0 Road Traffic Noise Assessment

The road traffic noise impacts associated with the Project have been assessed in accordance with the RNP.

Road traffic noise calculations were performed with CadnaA (Version 2021 MR 2), using the Calculation of Road Traffic Noise (CoRTN) algorithms. This model has been specifically validated under Australian conditions by the NAASRA Working Group (Saunders, Samuels, Leach & Hall, 1983).

The traffic noise impacts from the Project have been assessed based on existing traffic volume data (ref. *AUNSW3456 MATRIX ATC 7 Day Austroads 13 Italia Rd.xls*) provided by Matrix Traffic and Transport Data (Matrix), which was measured in 2022 for the traffic impact assessment undertaken for the Project.

6.1 Operation Traffic

The primary road haul route to and from the proposed Quarry will by the Pacific Highway and Italia Road. No Project trucks will travel along Italia Road north of the site access point (i.e. towards Seaham).

The following inputs and assumptions have been applied in evaluating the potential traffic noise impacts:

- Given existing traffic volume along the Pacific Highway (Average Annual Daily Traffic (AADT) in excess of 20,000 vehicles [ref: TfNSW 2018 Station ID T0482]), project related traffic noise impacts at receivers located along this road, are anticipated to be negligible.
- The existing traffic volumes for Italia Road have been derived from local traffic counts conducted in 2022, as provided by Matrix.
- Existing traffic noise levels are based on the measurements within **Table 2.4.**
- Daily traffic (6.00 am to 10.00 pm) generated during the Project's operation is estimated as 167 inbound heavy vehicles and 15 inbound light vehicles. The heavy vehicle estimation has been provided by ARDG and is based on the proposed maximum production (1.5 Mtpa). The light vehicle estimation is based on 10 full time and up to 5 part-time employees.
- The heavy vehicle movements would generally be spread across the day, however during busy periods it is expected that up to 18% of the average daily movements might occur during the peak operating hour, equivalent to 30 inbound and 30 outbound movements per hour.
- 50% of the daily project-related light-vehicle movements will be on the roads travelling to the Project during the night period (i.e. prior to 7.00 am) and half will travel to site from the north and half from the south.
- Operational (non-product) traffic movements along Italia Road north of the site access point are expected to be in the order of up 15 vehicles movements per day, therefore road traffic noise from these movements (including movements in the morning shoulder or evening period) is anticipated to be negligible at receivers located north of the access point.
- An Italia Road traffic speed is based on the measured 85th percentile speed data (79 km/hr) provided by Matrix.

- The nearest and potentially most affected receiver has been identified as 16 Italia Road, Balickera, which is located approximately 50 metres from the carriageway of Italia Road and 155m from the carriageway of the Pacific Highway.

- Based on the above inputs and assumptions, the operation traffic volumes adopted for the noise assessment are presented in **Table 6.1**.

Table 6.1 Operational Related Traffic Volumes

Location	Assessment Time Period	Parameter	Existing traffic volume (without Project)	Project Related traffic volume (2-way)	Combined traffic volume (Existing + Project)
Italia Rd south of site access point.	Day (7.00am – 10.00pm)	Light Vehicles	773	15	788
		Heavy Vehicles	441	313	754
		Total	1214	328	1542
	Night (10.00 pm – 7.00am) [1]	Light Vehicles	105	15	120
		Heavy Vehicles	72	21	93
		Total	177	36	213

Note: [1] Project related traffic only proposed during the morning shoulder period 6:00 am to 7:00 am.

Operator attended measurements at L2 (representative of 16 Italia Road) determined that the Pacific Highway, rather than Italia Road, was controlling traffic noise at this location (refer to **Table 2.3**). For this assessment, existing traffic noise levels are based on measurements (refer to **Table 2.4**), rather than predictions.

The assessment of operational traffic noise for the nearest receiver located along Italia Road is shown in **Table 6.2**.

Table 6.2 Assessment of Operational Traffic Noise, L_{Aeq}, dB(A)

Receiver	Time Period [1]	RNP criteria	Existing traffic noise levels [2]	Predicted Project traffic noise levels	Combined traffic noise levels	Noise Level Change due to Project	Comply / Exceed
16 Italia Road, Balickera	Day $L_{Aeq(15\ hour)}$	60	60	52	60	N/A [3]	Complies
	Night $L_{Aeq(9\ hour)}$	55	58	43	58	N/A [3]	Complies

Notes: [1] Daytime is 7:00 am-10:00 pm and Night is 10:00 pm-7:00 am.

[2] Based on traffic noise levels within **Table 2.4**.

[3] Change in noise level assessment is not applicable if the predicted noise level is below the noise limit.

As shown in **Table 6.2** the operational traffic noise levels are predicted to comply with the criteria. In accordance with the RNP the Project construction traffic noise is predicted to be acceptable and have minor impact.

6.2 Construction Traffic

ARDG have advised that construction traffic movements are expected to be in the order of 8 heavy vehicles and 15 light vehicles per day. Operational traffic noise levels were found to comply in **Section 6.1**, based on a much higher number of daily vehicles (167 heavy and 15 light). Therefore, road traffic noise from construction traffic is predicted to comply and is anticipated to be negligible.

7.0 Monitoring and Management

7.1 Noise Management Plan

A Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP) will be developed and implemented which will include the following monitoring and management controls to manage potential noise impacts associated with construction activities and site operations. This includes:

- noise objectives and targets consistent with the Development Consent
- noise management measures in place at the site (refer to **Sections 7.2** and **7.3**)
- provision of general noise awareness training for key operational staff
- noise monitoring processes implemented at the site to provide for ongoing noise management, including monitoring and determination of compliance with relevant noise criteria provided in the Development Consent (refer to **Section 7.4**)
- stakeholder consultation
- complaint/enquiry handling process including maintenance of a 24-hour community contact line
- a roles and responsibilities matrix, with responsibilities being clearly defined through all levels within the operation.

7.1.1 Change Management Process

During the operational phase of the Project, it is recommended the OEMP include a change management process that is implemented, at a minimum, in the following instances:

- When significant changes are made to the number of equipment items or type of equipment utilised on the site, providing for evolving technology and equipment changes, to ensure the potential risk of noise criteria being exceeded is minimised.
- Prior to the purchase or rental of equipment that, by its size or capacity, has the potential to result in exceedance of noise criteria.

The change management process should consider the noise performance of the Project and the impact the proposed changes may have on the operational noise levels. It is also recommended the OEMP include a trigger to initiate noise modelling of the predicted noise emissions from operational changes that may result in non-compliance with the relevant statutory approval(s).

7.1.2 Trigger Action Response Plan

It is recommended that the CEMP/OEMP include the development of a Trigger Action Response Plan (TARP) that includes an Incident Investigation and Response process that:

- is implemented following notification of elevated noise levels through compliance/validation measurements or complaint
- records the actions taken by site personnel following notification of elevated noise levels including mitigation measures undertaken to achieve compliance
- in the event that an exceedance of the noise impact assessment criteria is identified, guides the notification process for relevant government agencies and any affected landowners within the statutory timeframe.

If a non-compliance is identified or a request for installation of noise impact mitigation measures is received, the CEMP/OEMP will document the corrective or preventative actions to be implemented in accordance with the Development Consent. This will also include a review process required to assess the effectiveness of the corrective/preventative action taken and specify the timeframe for the review following the implementation of the corrective action.

7.1.3 Incident Investigation and Response

In the event that an exceedance of the noise criteria is identified, ARDG will notify the relevant government agencies, report within the statutory timeframes and liaise with any affected landowners.

7.2 Operational Noise Mitigation and Management

Operational noise mitigation measures have been documented in **Section 4.2**.

7.3 Construction Noise Mitigation and Management

The construction noise and vibration impacts have been assessed in accordance with ICNG. The construction noise levels are predicted to comply with both the nominated noise management levels in the ICNG and the PNTLs for operational activities. Nevertheless, the below reasonable and feasible noise management and mitigation strategies have been provided. Whilst it is not essential to adopt these measures, in accordance with the ICNG, it is considered best practice to minimise construction noise as much as possible.

The following noise and vibration mitigation measures should be implemented during construction of the Project:

- All sensitive receivers likely to be affected should be notified at least 7 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification should include:
    - details of the Project
    - the construction period and construction hours

- contact information for project management staff
- complaint and incident reporting
- how to obtain further information.

- All employees, contractors and subcontractors are to receive an environmental induction. The induction must include at a minimum, all applicable mitigation measures; hours of works; any limitations on high noise-generating activities; location of nearest sensitive receivers; designated parking areas; relevant approval conditions and incident procedures.
- Contractors should keep noise to a minimum, including limiting the use of loud stereos/radios, shouting on site and car door slams.
- Where practical, no dropping of materials from height or throwing of metal items.
- The noise levels of plant and equipment should have operating sound power levels consistent with those nominated in Table 5.1.
- Noise emitting plant to be directed away from sensitive receivers and to be throttled down or shut down when not in use.
- Non-tonal reversing beepers could be fitted and used on construction vehicles and mobile plant used regularly on site and for any out of hours work.
- Limit the use of engine compression brakes.
- Any construction activities outside of standard construction hours will be managed to meet operational noise criteria for the Project.

7.4 Monitoring

Noise monitoring at the proposed Quarry will take the form of compliance monitoring and validation monitoring. Compliance monitoring is via attended monitoring at defined locations, at regular intervals. Validation monitoring is to take place at the same time as the compliance monitoring to confirm the noise model predictions and accuracy of the noise model.

Given compliance with the PNTLs is predicted during the day period and readily predicted during the morning shoulder and evening period, performance-based management monitoring (including real-time monitoring) is not considered to be necessary and is therefore not recommended at this stage. Performance-based monitoring would only be considered necessary is, once the quarry is operational, compliance (refer **Section 7.4.1**) and validation (refer **Section 7.4.2**) monitoring indicate noise impacts from the quarry are higher than predicted and approach applicable PNTLs established under the NPfI.

Further details on each type of recommended monitoring are provided in the sections below and suggested monitoring locations are shown on **Figure 7.1**.

7.4.1 Compliance Noise Monitoring

It is recommended that attended monitoring for compliance assessment is completed at three (3) locations surrounding the Quarry that are considered to be representative of the most sensitive noise receivers. As the project is only operating during day-time periods only and is not predicted to exceed PNTLs, annual compliance monitoring is considered to be adequate to addresses potential risks from the Project. The attended noise monitoring locations (NM01, NM02 and NM03) shown in **Table 7.1** and **Figure 7.1** will be reviewed periodically to ensure monitoring is undertaken at appropriate representative locations. Any changes will be reflected in amendments to the OEMP prior to being implemented.

Table 7.1 Recommended Compliance Noise Monitoring Locations and Criteria

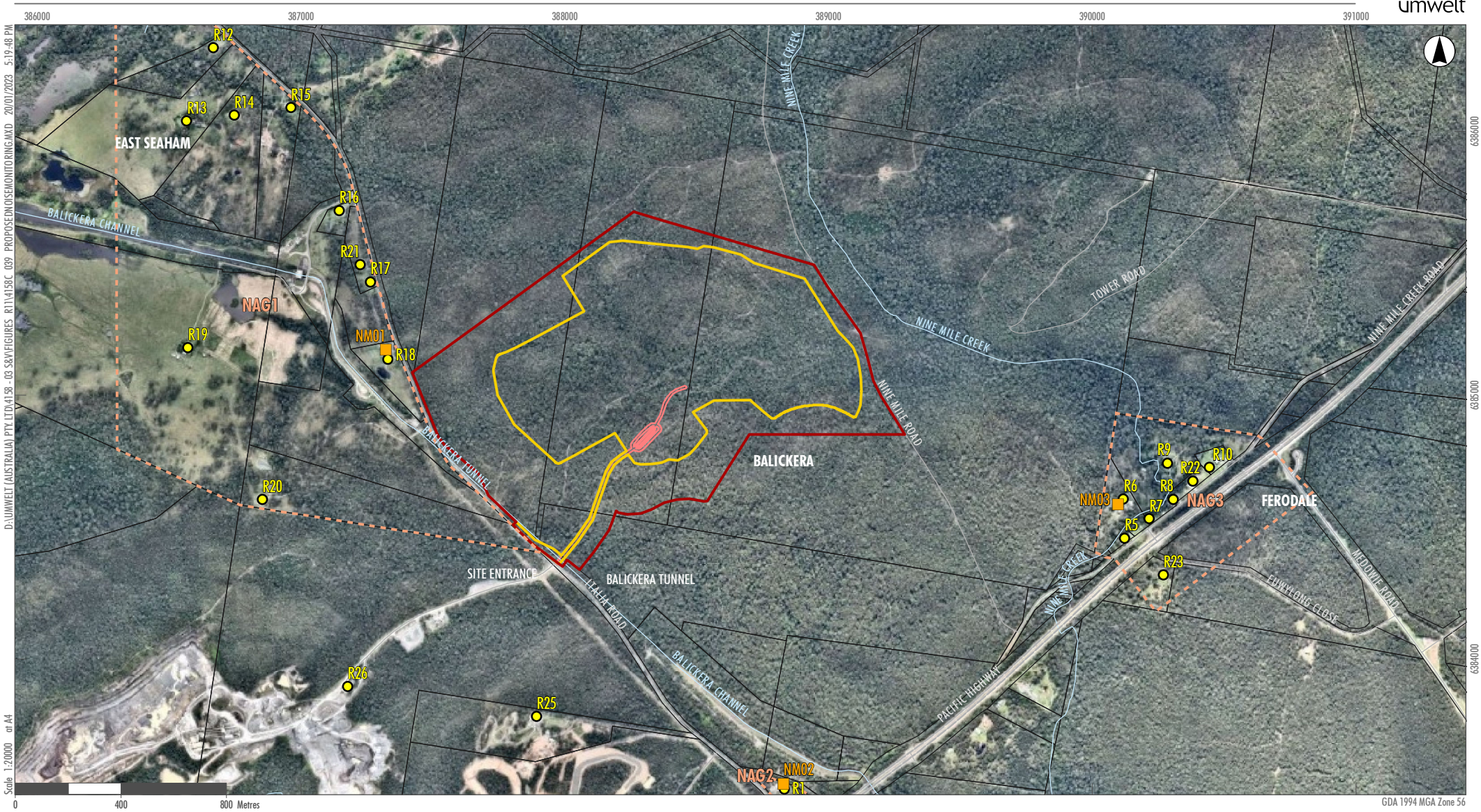
Attended Noise Monitoring Location	Receiver Area/Residences represented by monitoring location	Possible real-time noise monitor location [1]	Closest privately owned residence	Proposed Noise Monitoring Criteria for the Revised Project, dB(A)	
				Day/Evening/Night/MS $L_{Aeq,15minute}$	Night LA1,1minute
NM01	NAG_1	241 Italia Road, Balickera	R18	40/36/35/40	52
NM02	NAG_2	16 Italia Road, Balickera	R1	53/46/43/47	57
NM03	NAG_3	5 Nine Mile Creek Road, Ferodale	R6	53/44/42/47	57

Note: [1] Alternate location will be sought if consent for the monitor(s) is not granted by the property owner

7.4.2 Validation Monitoring

Validation monitoring can take place at the same time as the compliance monitoring. Whilst the purpose of the compliance measurements is to establish compliance with the noise limits, validation monitoring will confirm the noise model predictions and validate the noise model to determine its accuracy. This will provide confidence in the noise level predictions for subsequent quarry stages.

The validation monitoring process can determine if the noise model is under predicting and a whether a potential non-compliance is likely to occur for the current stage or future stage(s). The noise model can be updated to provide a more robust indication of future compliance and allow for the early anticipation / implementation of any additional feasible mitigation measures. As part of the continuous improvement process, it is proposed that validation monitoring occurs continuous throughout the life of the operation.



Legend

- Project Area
- Disturbance Area
- Attended Noise Monitoring (NM) Location
- Sensitive Receivers
- Noise Assessment Groups (NAG)
- Pacific Highway
- Road
- Drainage Line
- Lots
- Access Road

FIGURE 7.1

Proposed Noise Monitoring Locations

Image Source: Nearmap (2022) Data source: NSW FSDF (2022)

8.0 Conclusion

An assessment of the potential noise and vibration impacts associated with the construction and operation of the Project has been prepared. Potential construction noise and vibration and vibration impacts have been assessed in accordance with the Interim Construction Noise Guideline (ICNG, 2009). The assessment found that construction noise levels are predicted to comply with the established noise management levels.

Potential operational noise levels have been assessed in accordance with the Noise Policy for Industry (NPfI, 2017). This assessment found that the Project is expected to comply with the applicable day, evening and morning shoulder assessment criteria calculated in accordance with NPfI methodology at all nearby sensitive receivers. No exceedances of the operational cumulative noise criteria were predicted.

The proposed operational noise criteria for the Project is set out in **Table 8.1** and is based on the PNTLs established for each receiver/NAG and the calculated NPfI sleep disturbance screening criteria.

Table 8.1 Proposed Noise Criteria for Project

Receiver	Period Criteria (dB LA_{15Min})				Night – Sleep Disturbance (dB LA_{Max})
	Day	Evening	Night	Morning Shoulder (6am-7am)	
NAG 1	40	36	35	40	52
NAG 2	53	46	43	47	57
NAG 3	53	44	42	47	57
Any other residential Receiver (Hwy influence)	53	44	42	47	57
Any other Residential Receiver -Rural	40	35	35	40	52
Industrial Receivers[2]	68 (When in use)				N/A
Active Recreational Receiver	53 (When in use)				N/A

Notes: 1 Day period is 7.00 am-6.00 pm Monday-Saturday and 8.00 am-6.00 pm Sunday and Public Holidays, evening period is 6.00 pm-10.00 pm and night period is 10.00 pm to commencement of morning shoulder or day period. Shoulder period is 6:00 am-7:00 am Monday-Saturday and 7:00 am-8.00 am Sunday and Public Holidays.

2. Includes Quarries and Motor Sports facilities including the Ringwood Park Motorsport Facility and the Circuit Italia

Potential structural damage and human annoyance from vibration inducing operational and construction equipment is anticipated to be negligible, due to the minimum separation distance between the Disturbance Area and the nearest affected receivers (320 m). Note potential vibration impacts associated with blasting is addressed in a separate Blast Impact Assessment.

Operational and construction road traffic noise has been assessed and was found to comply at the nearest most potentially affected dwelling. Recommended monitoring and management measures, including recommended compliance monitoring locations, have been provided.

9.0 References

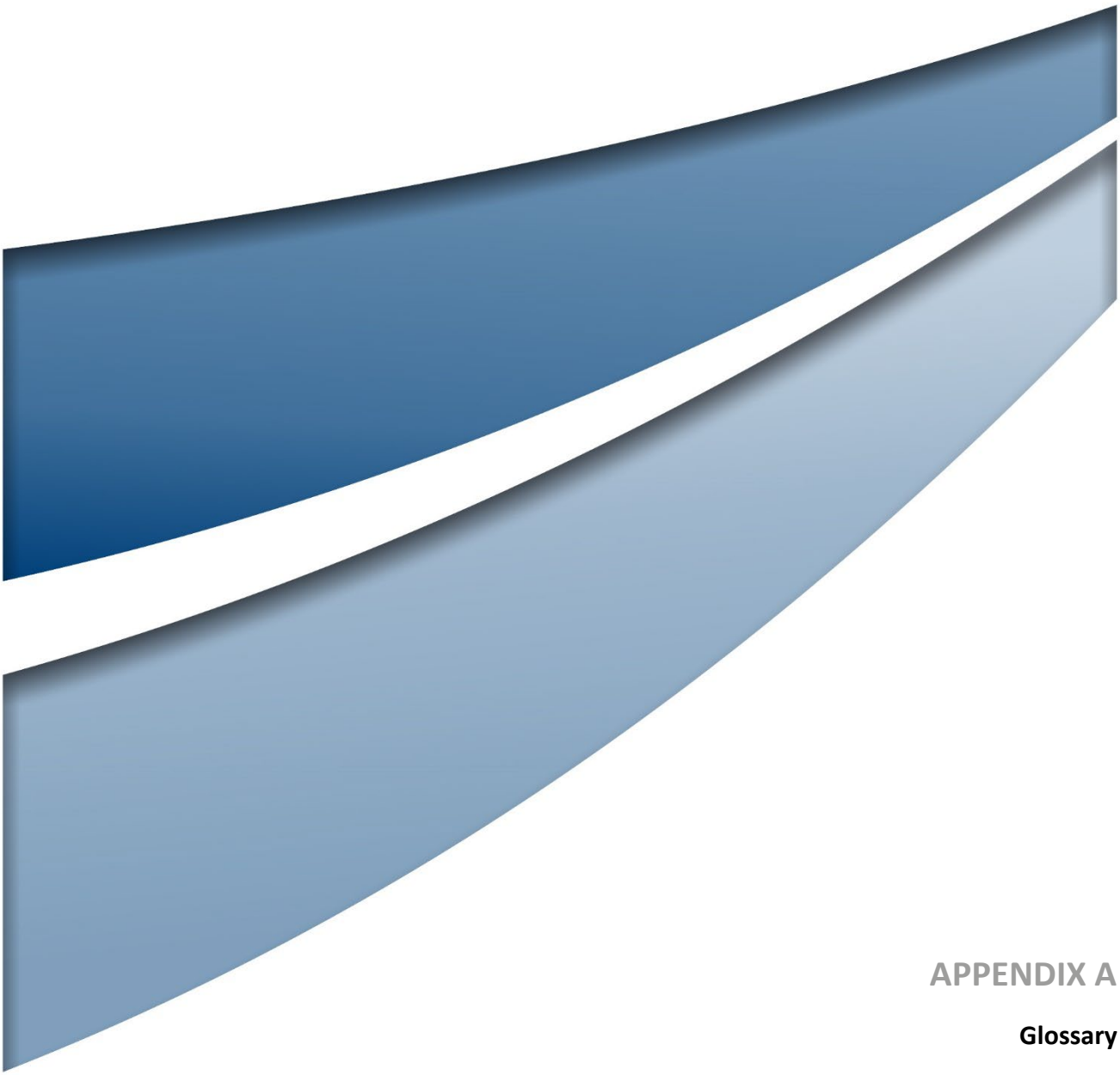
Australian Standard 1055-2018. Acoustics – Description and measurement of environmental noise

Department of Environment and Climate Change, 2009. *Interim Construction Noise Guideline (ICNG)*

Department of Environment, Climate Change & Water, 2011. *NSW Road Noise Policy (RNP*)

NSW Environment Protection Authority, 2017. *Noise Policy for Industry (NPfI)*

NSW Government, 2014. *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments*



APPENDIX A

Glossary

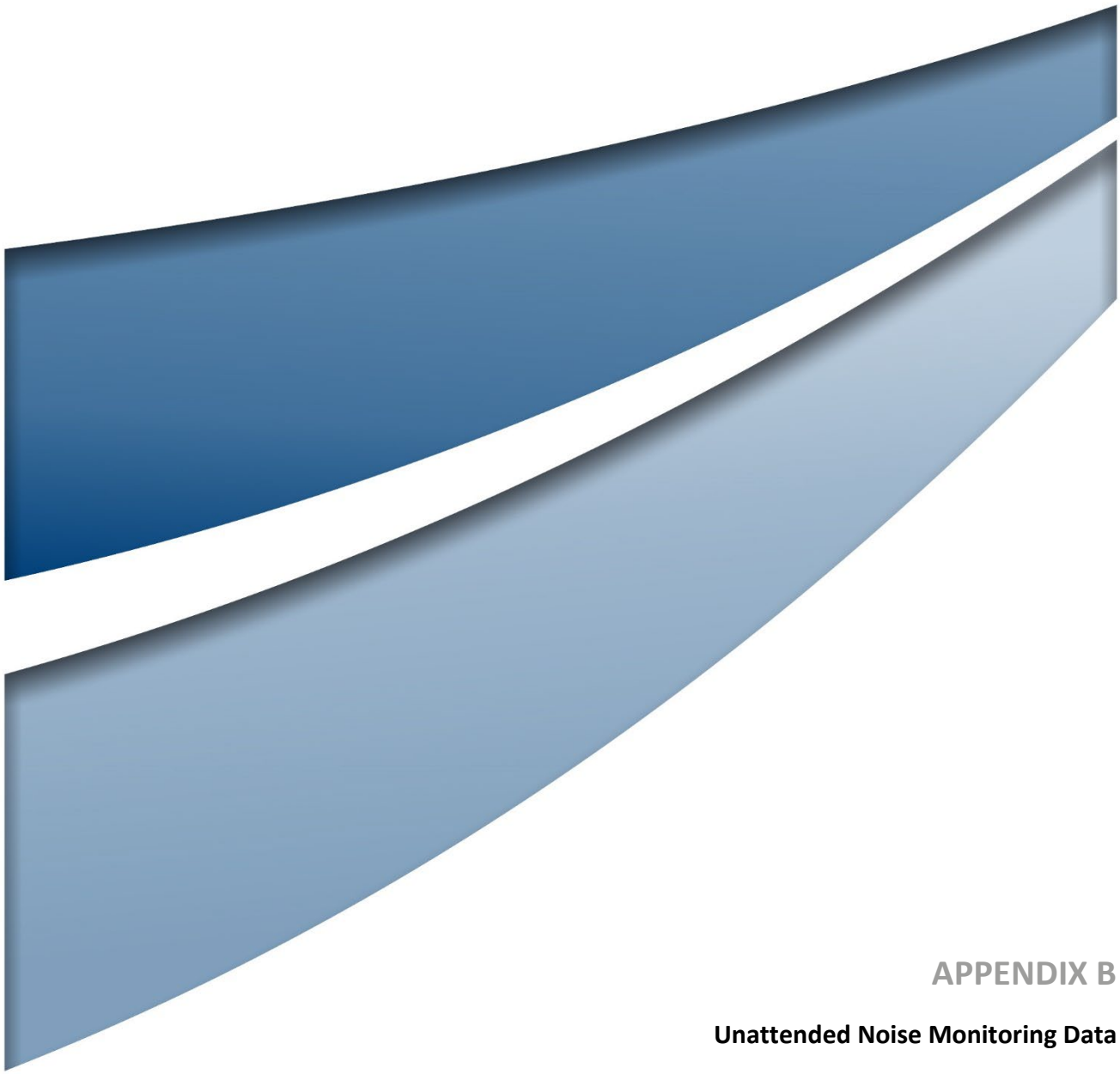
Glossary

Table A1 provides descriptions of terms and abbreviations which may be used in this report.

Table A1 Glossary of Terms and Abbreviations

Term	Description
1/3 Octave	Single octave bands divided into three parts.
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment background level - A single-figure background noise level representing each assessment period – day, evening and night (that is, three assessment background levels are determined for each 24 hour period of the monitoring period). It is determined by taking the lowest 10th percentile of the L_{90} level for each assessment period.
Ambient Noise	The noise associated with a given environment. Typically, a composite of sounds from many sources located both near and far where no particular sound is dominant.
Recommended Amenity Noise Level	Recommended noise levels scaled to reflect the perceived differential expectations and ambient noise environments of rural, suburban and urban communities for sensitive receivers.
Assessment Background Level (ABL)	The single-figure background level representing each assessment period: day, evening and night (that is, three assessment background levels are determined for each 24-hour period of the monitoring period). Its determination is by the methods described in Fact Sheet B.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dB(A), dBA	Decibels A-weighted.
dB(C), dBC	Decibels C-weighted.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Day	The period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays
Decibel (dB)	The units of sound level and noise exposure measurement where a step of 10 dB is a ten-fold increase in intensity or sound energy and actually sounds a little more than twice as loud.
Evening	Refers to the period from 6 pm to 10 pm.
Hertz (Hz)	The measure of the frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
L_{A10}	The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis. Typically used to assess the impact of an existing operation on a receiver area and is referred to as the cumulative noise levels at the receiver attributable to the noise source.
L_{A90}	Background Noise Level. The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.
L_{Amax}	The maximum of the sound pressure levels recorded over an interval of 1 second.
$L_{A1,1minute}$	The measure of the short duration high-level noises that cause sleep arousal. The noise level is measured as the percentile sound pressure level that is exceeded 1% of measurement period with 'A' frequency weighting calculated by statistical analysis during a measurement time interval of 1 minute.

Term	Description
$L_{Aeq,t}$	Equivalent continuous sound pressure level - The value of the sound pressure level of a continuous steady noise that, a measurement interval of time (t), has the same mean square sound pressure as the sound under consideration whose level varies with time. Usually measured in dB with 'A' weighting.
L_{An}	Percentile level - A measure of the fluctuation of the sound pressure level which is exceeded 'n' percent of the observation time.
Morning Shoulder Period	Refers to the period from 6 am to 7 am
Noise Assessment Groups (NAG)	Residential receivers are grouped into NAGs. The allocation of NAGs is based on the similarity of the acoustic environments and project noise trigger levels (PNTL) identified for individual receivers.
Night	The period between 10 am and 7 pm
Project Noise Trigger Levels (PNTL)	Target noise levels for a particular noise-generating facility. They are based on the most stringent of the project intrusiveness noise level or the project amenity noise level.
Project Amenity Noise Levels	The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Calculated as the recommended amenity noise level less 5 decibels and refers to the day, evening and night periods.
Project Intrusive Noise Levels	The project intrusiveness noise level aims to protect against significant changes in noise levels. Calculated as rated background level plus 5 decibels and refers to a 15-minute period.
Receiver	The noise-sensitive land use at which noise from a development can be heard.
Rating Background Noise level (RBL)	The overall single figure background level representing each assessment period over the whole monitoring period determined by taking the median of the ABLs found for each assessment period.
Sleep Disturbance	Awakenings and disturbance to sleep stages.
Sound Pressure Level (dBA)	The basic measure of noise loudness. The level of the root-mean-square sound pressure in decibels given by: $SPL = 10.\log10\ (p/po)^2$ where p is the rms sound pressure in pascals and po is the sound reference pressure at 20 uPa db.
Sound Power Level	A measure of the energy emitted from a source as sound and is given by: $SWL = 10.\log10\ (W/Wo)$ where W is the sound power in watts and Wo is the sound reference power at 10^{-12} watts.
Temperature Inversion	An atmospheric condition in which temperature increases with height above the ground.



APPENDIX B

Unattended Noise Monitoring Data

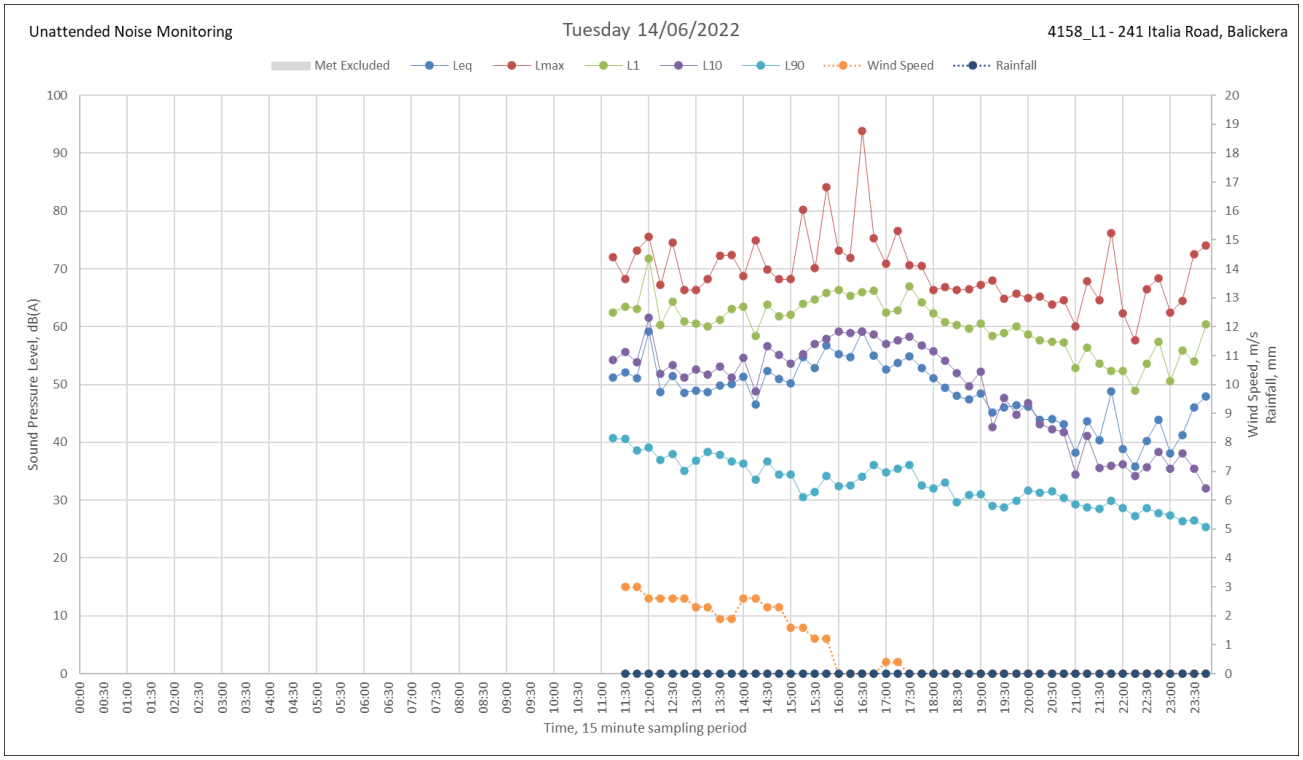


Figure B1.1 Unattended noise measurement at L1

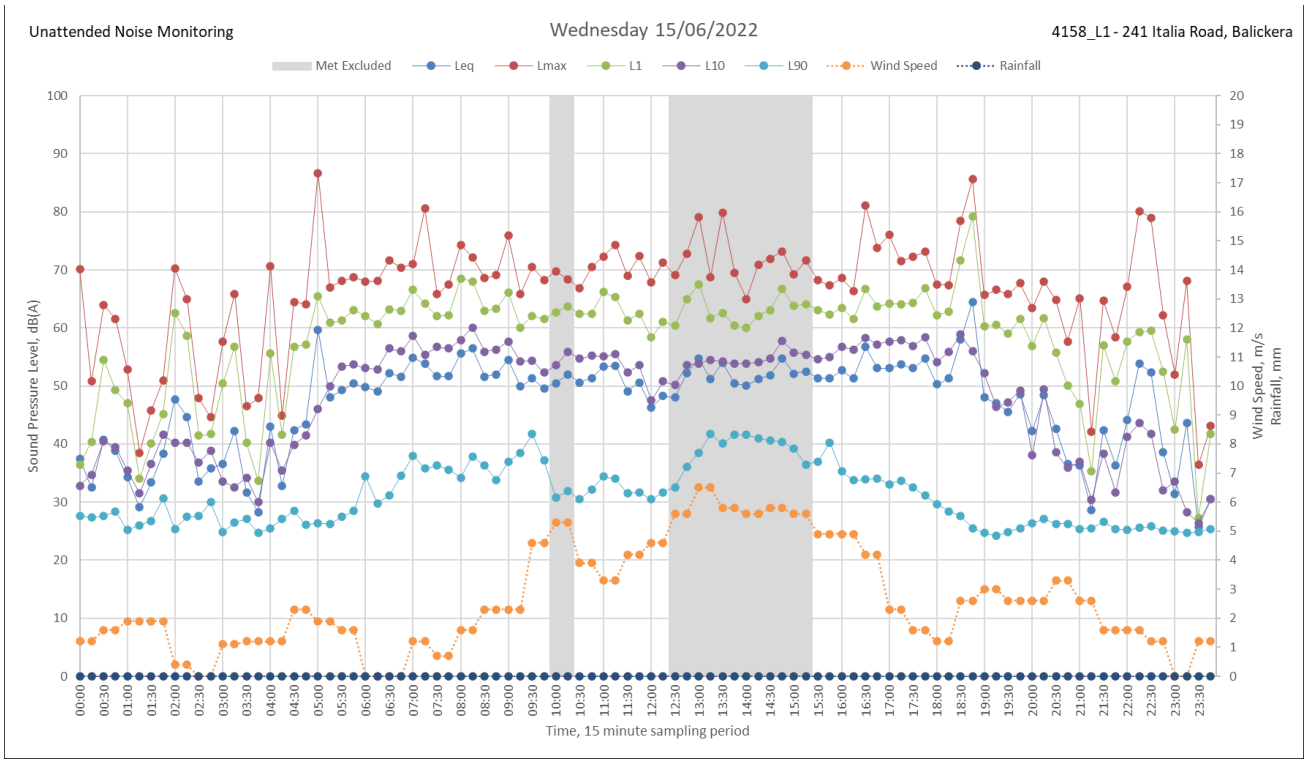


Figure B1.2 Unattended noise measurement at L1

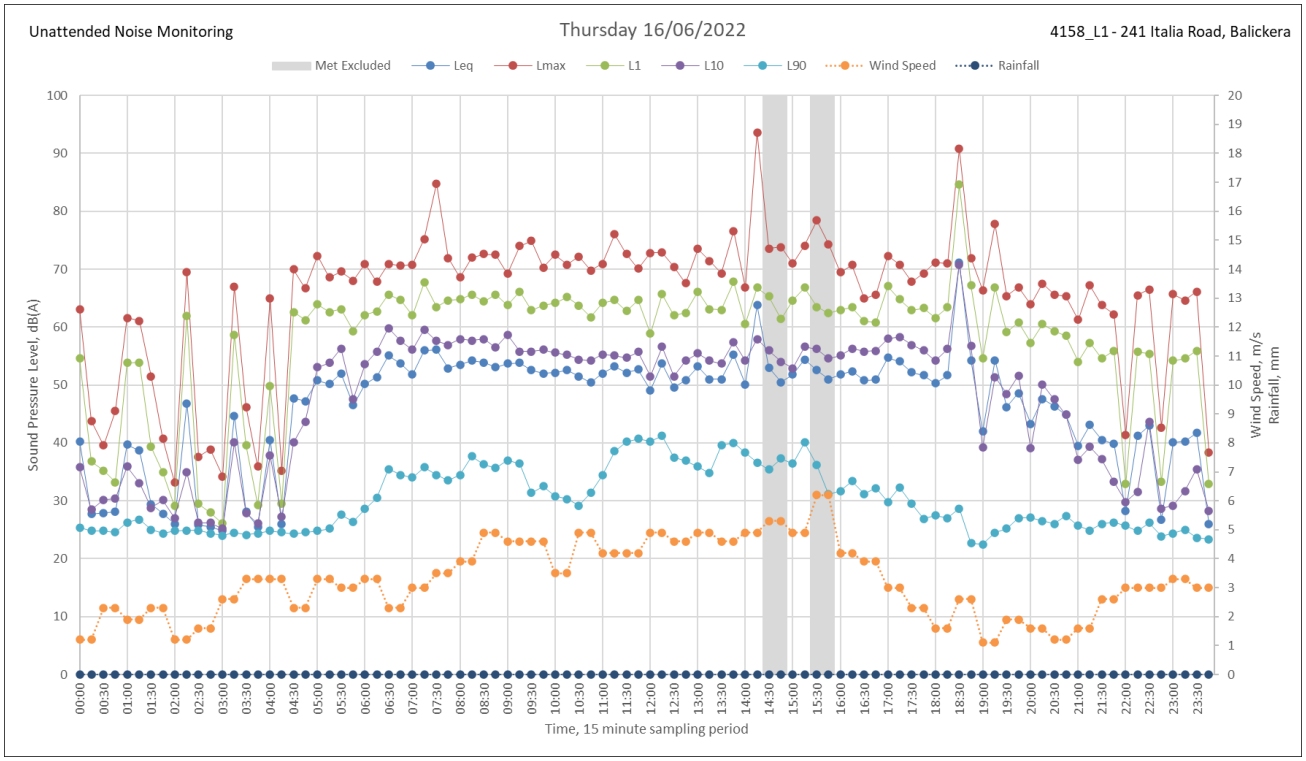


Figure B1.3 Unattended noise measurement at L1

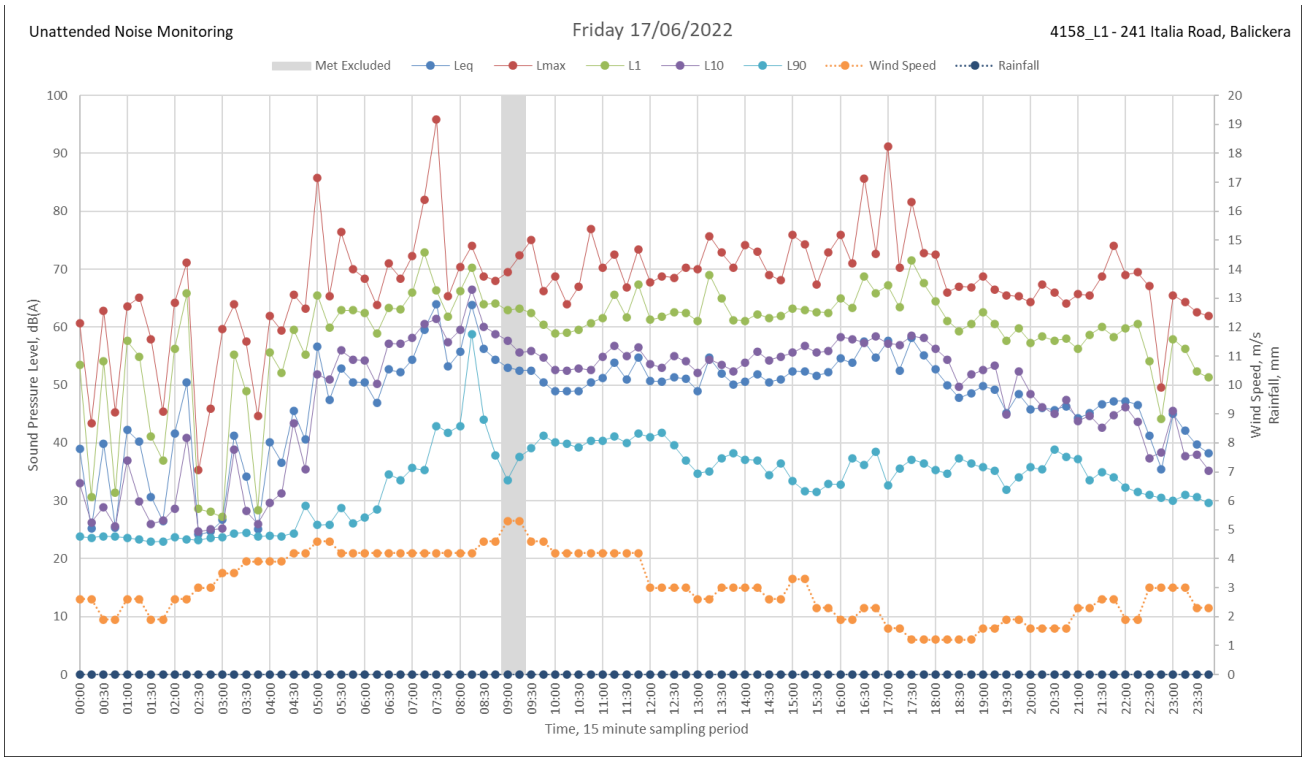


Figure B1.4 Unattended noise measurement at L1

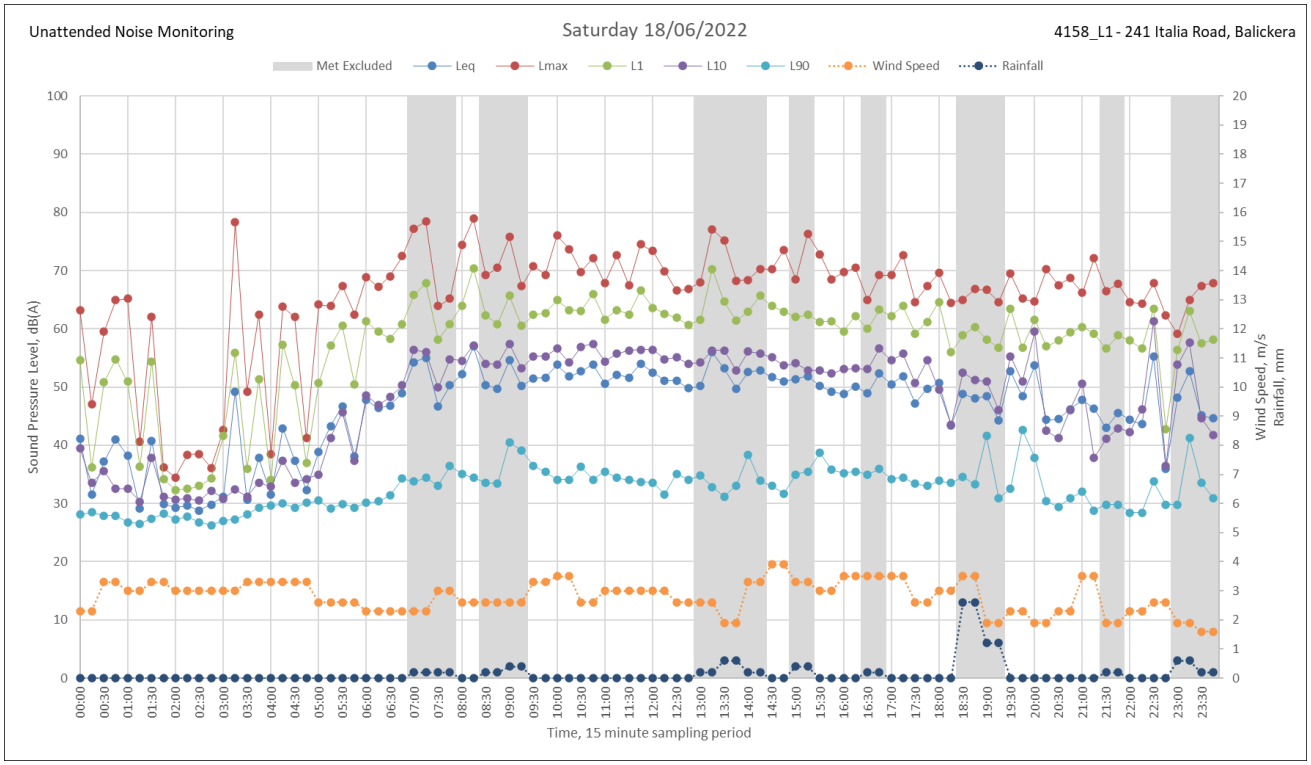


Figure B1.5 Unattended noise measurement at L1

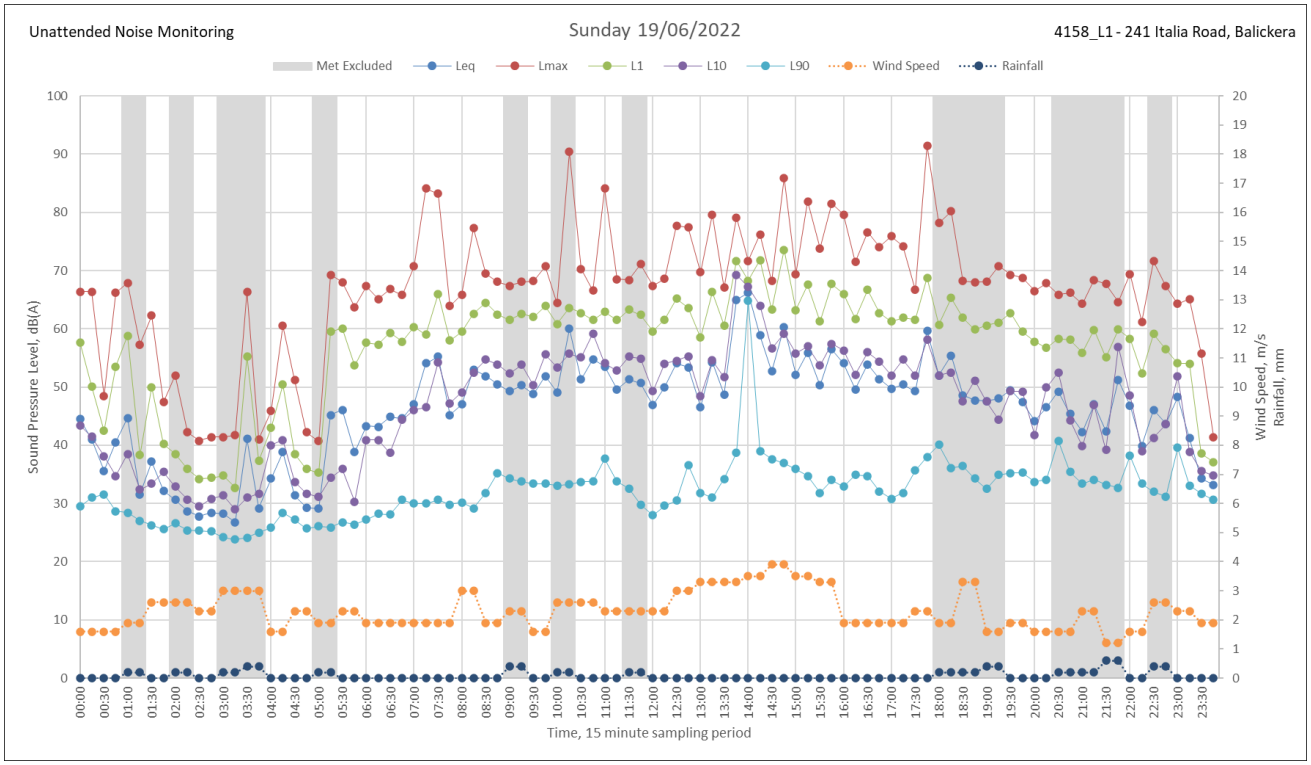


Figure B1.6 Unattended noise measurement at L1

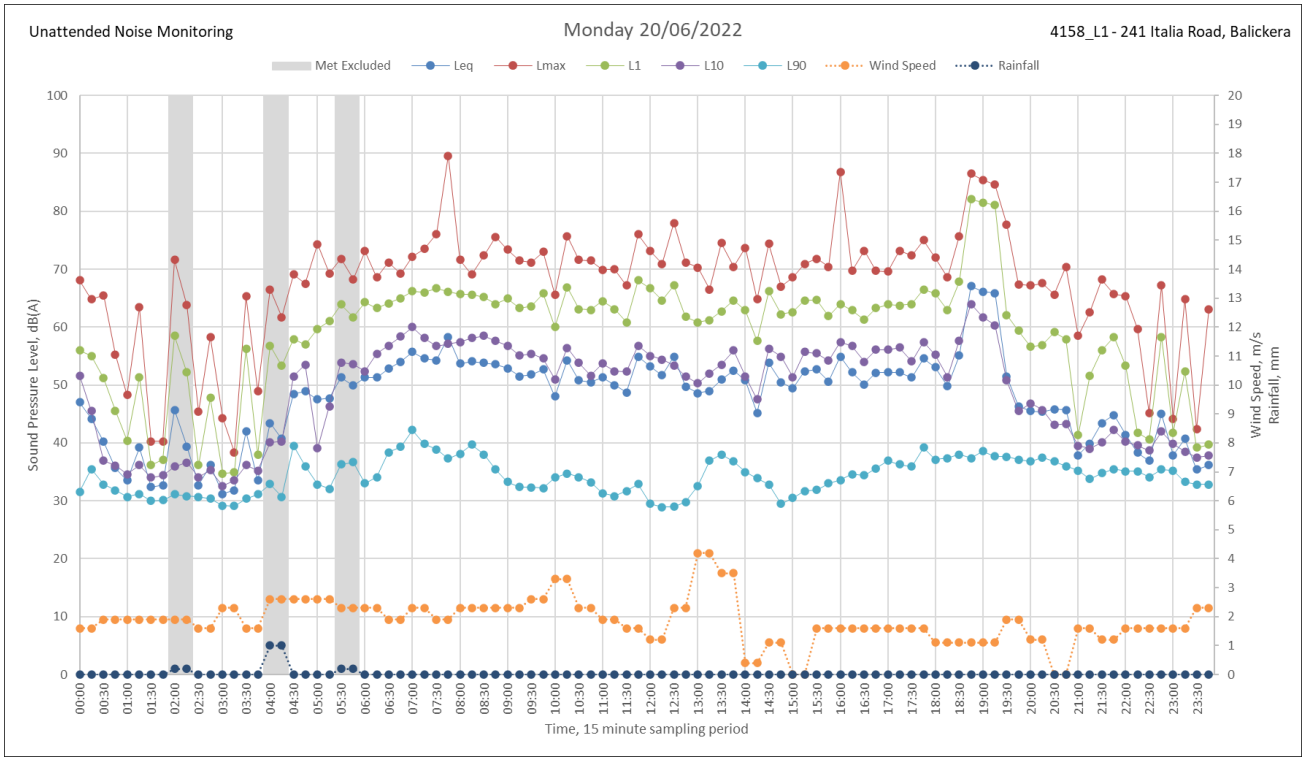


Figure B1.7 Unattended noise measurement at L1

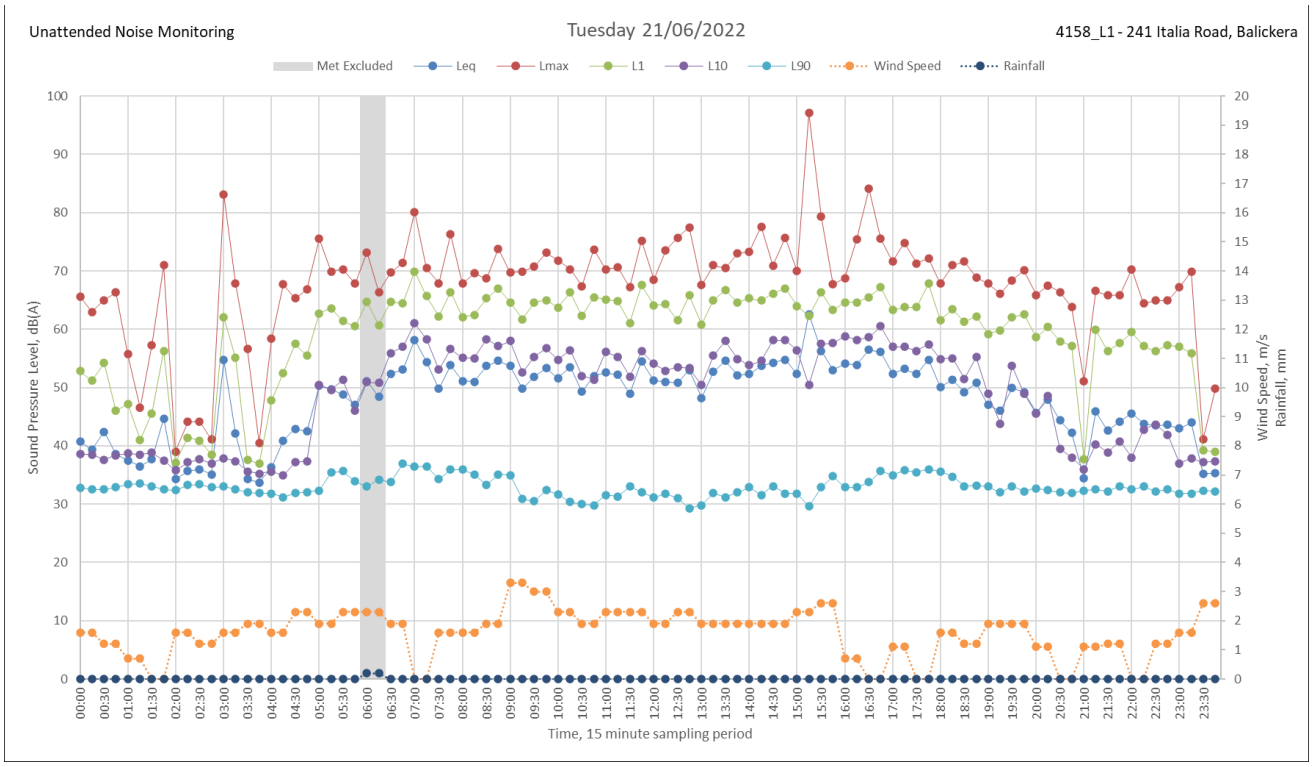


Figure B1.8 Unattended noise measurement at L1

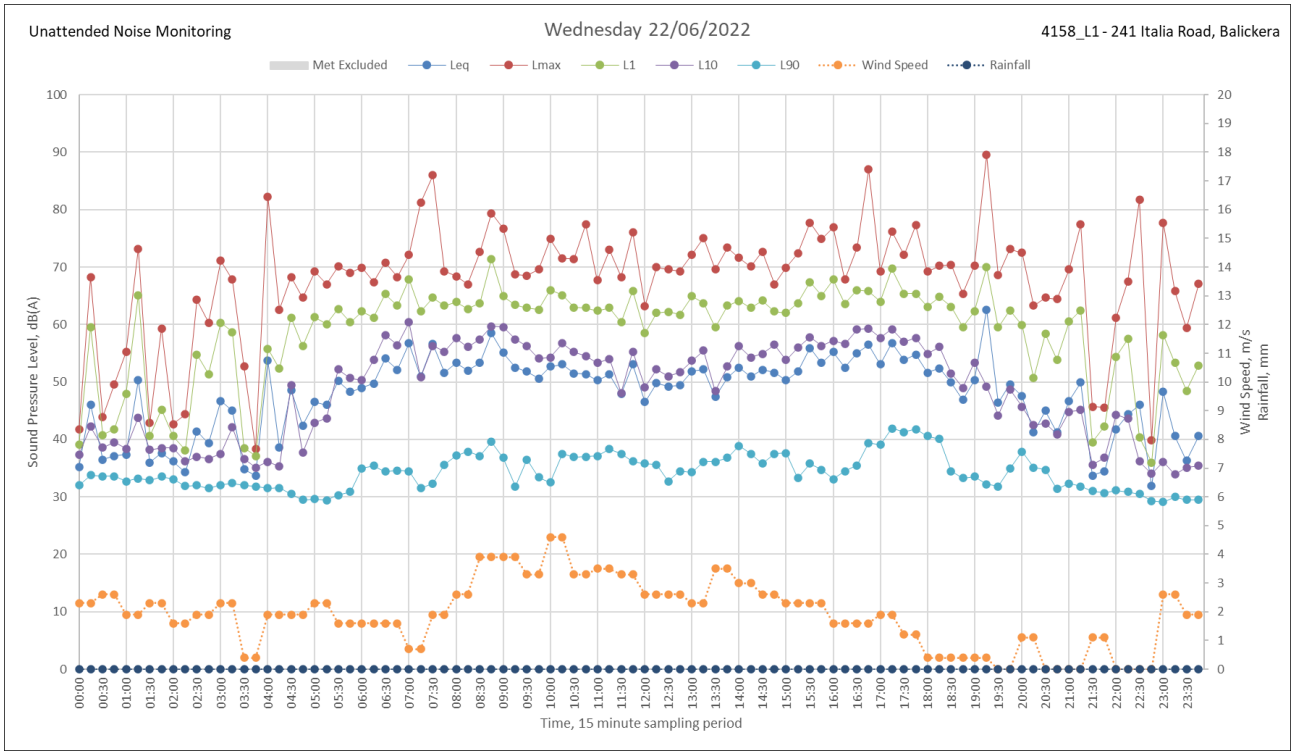


Figure B1.9 Unattended noise measurement at L1

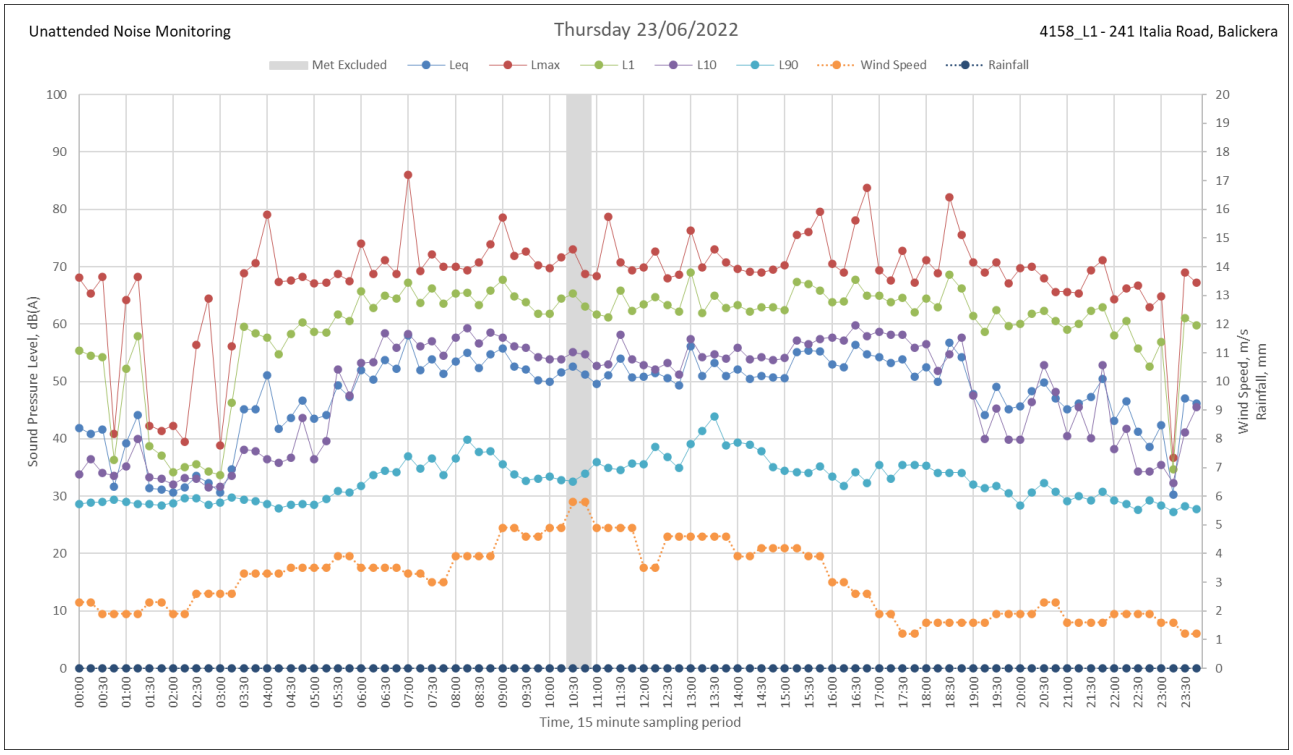


Figure B1.10 Unattended noise measurement at L1

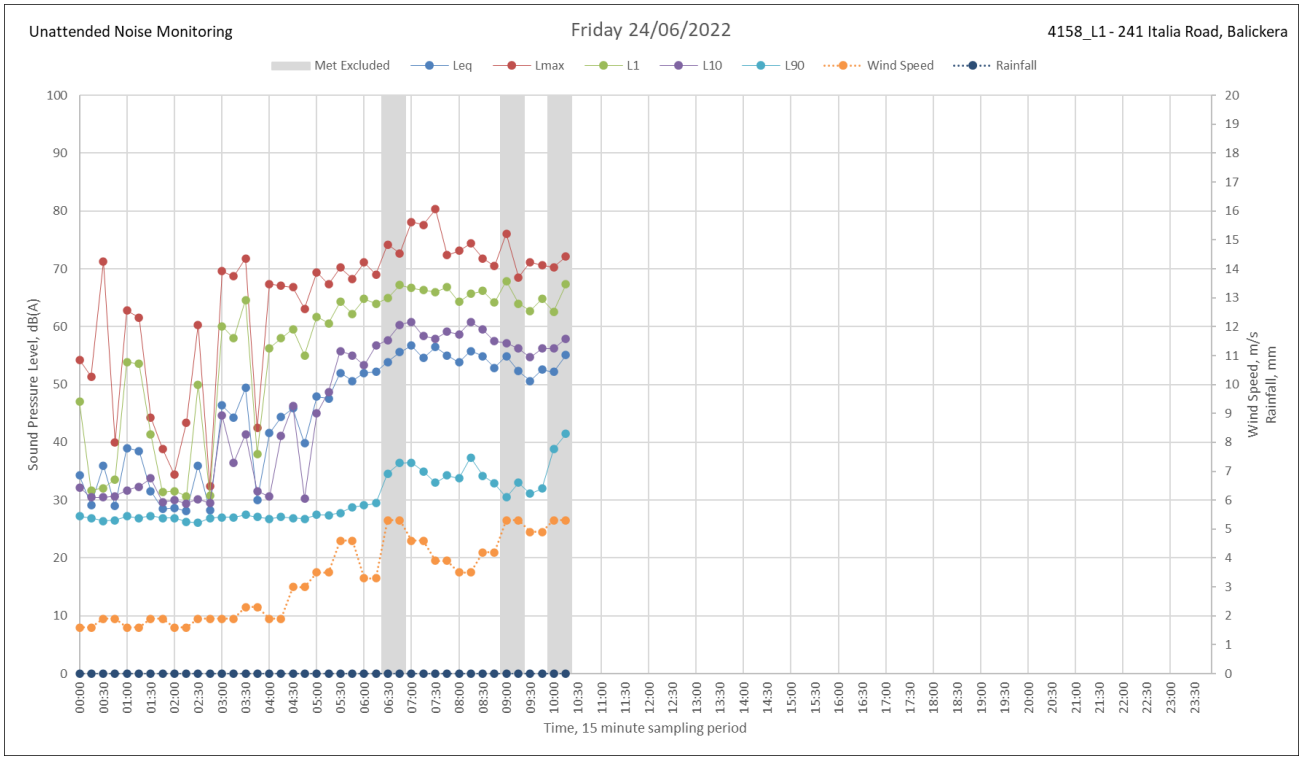


Figure B1.11 Unattended noise measurement at L1

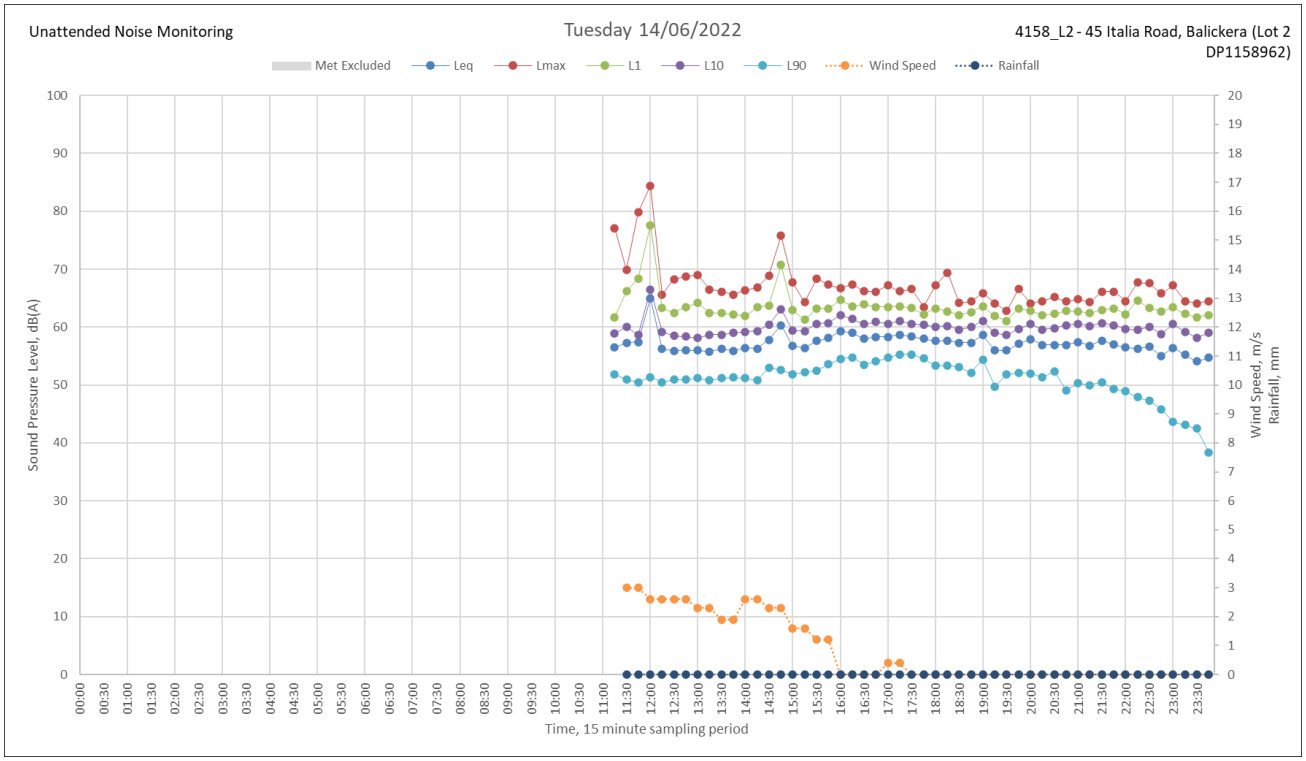


Figure B2.1 Unattended noise measurement at L2

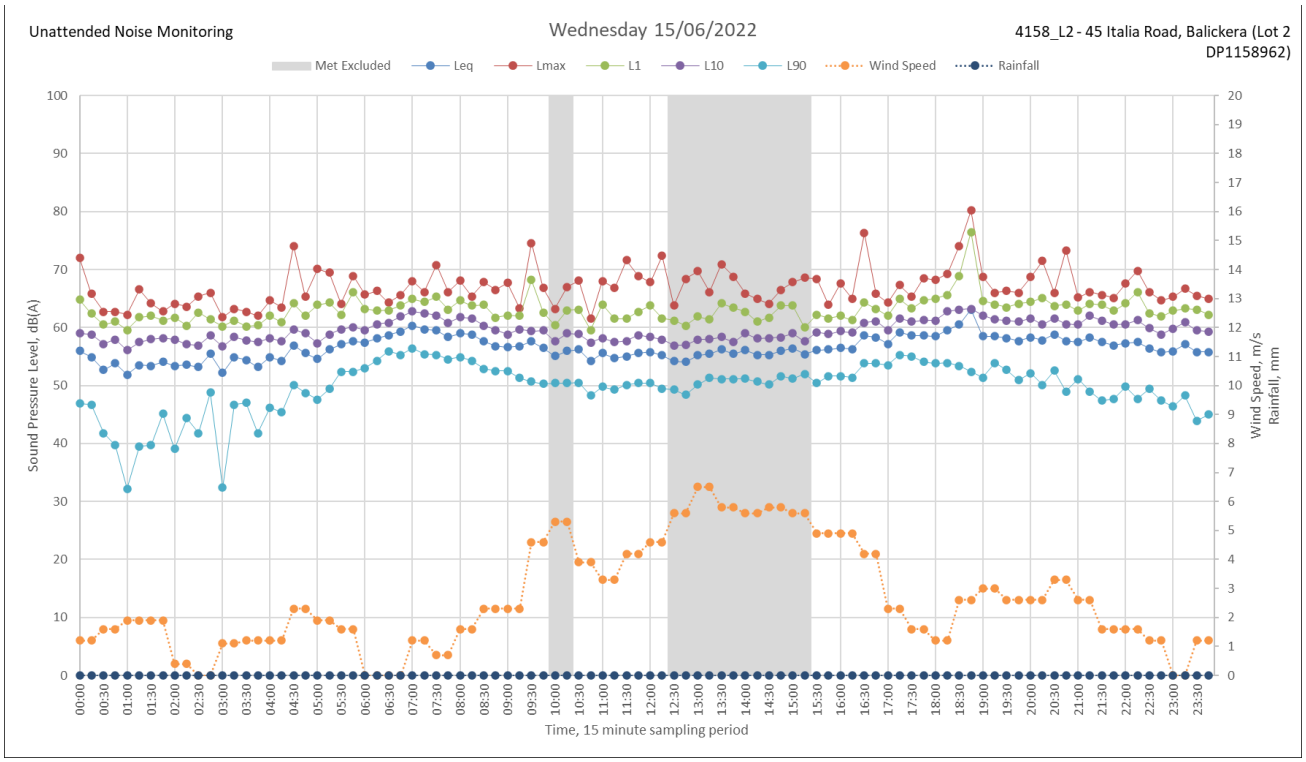


Figure B2.2 Unattended noise measurement at L2

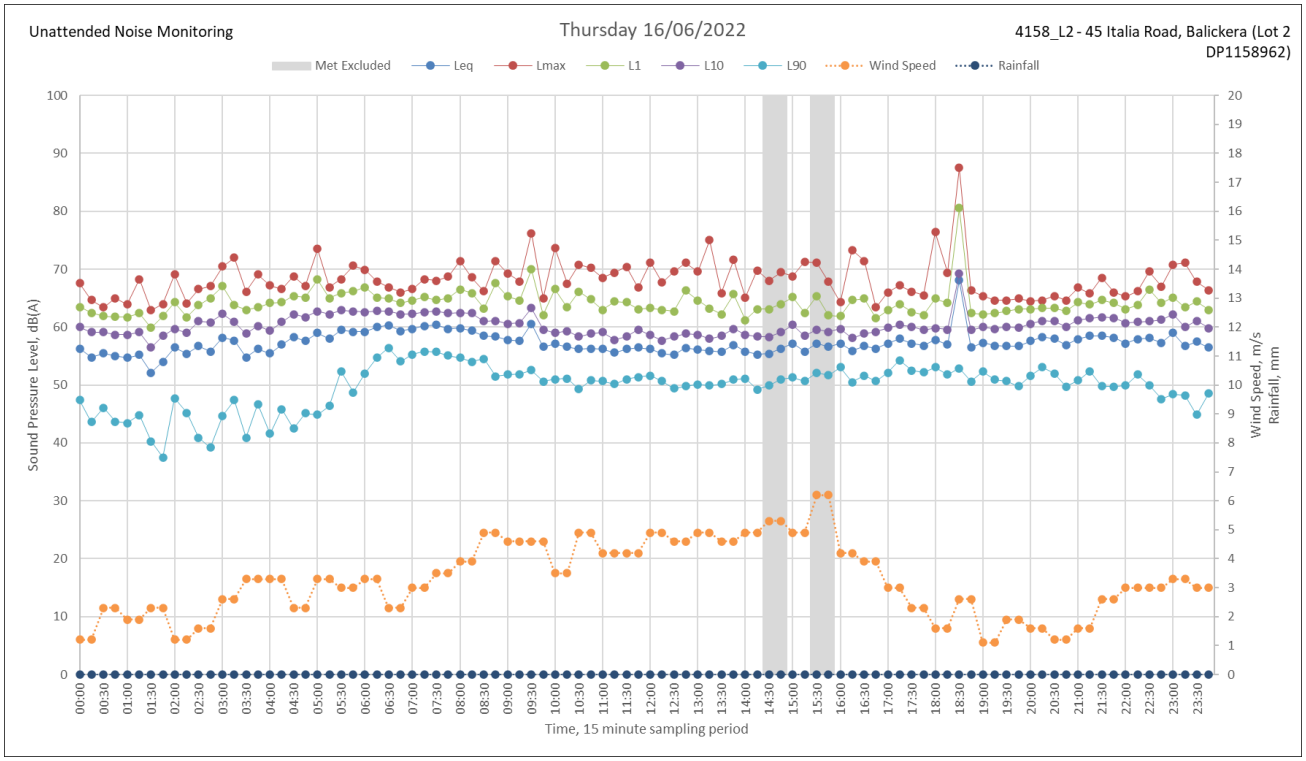


Figure B2.3 Unattended noise measurement at L2

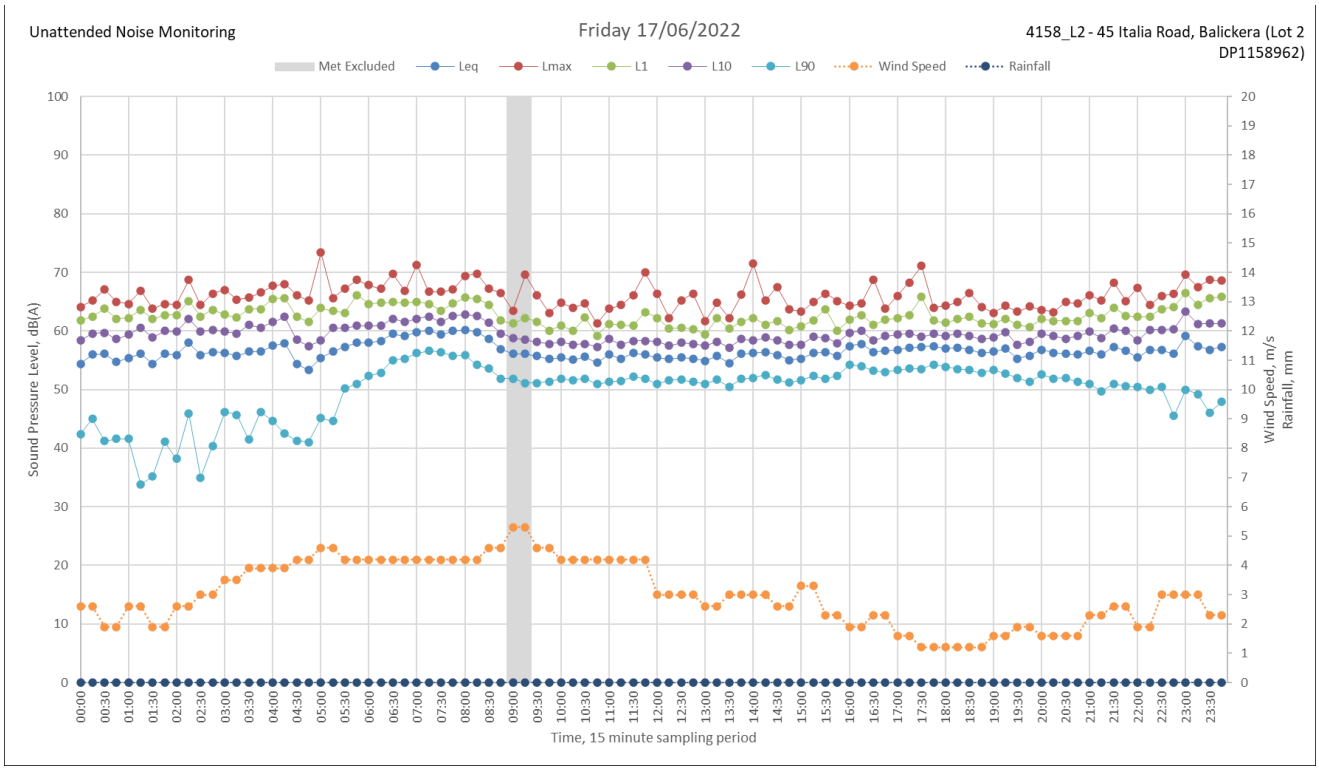


Figure B2.4 Unattended noise measurement at L2

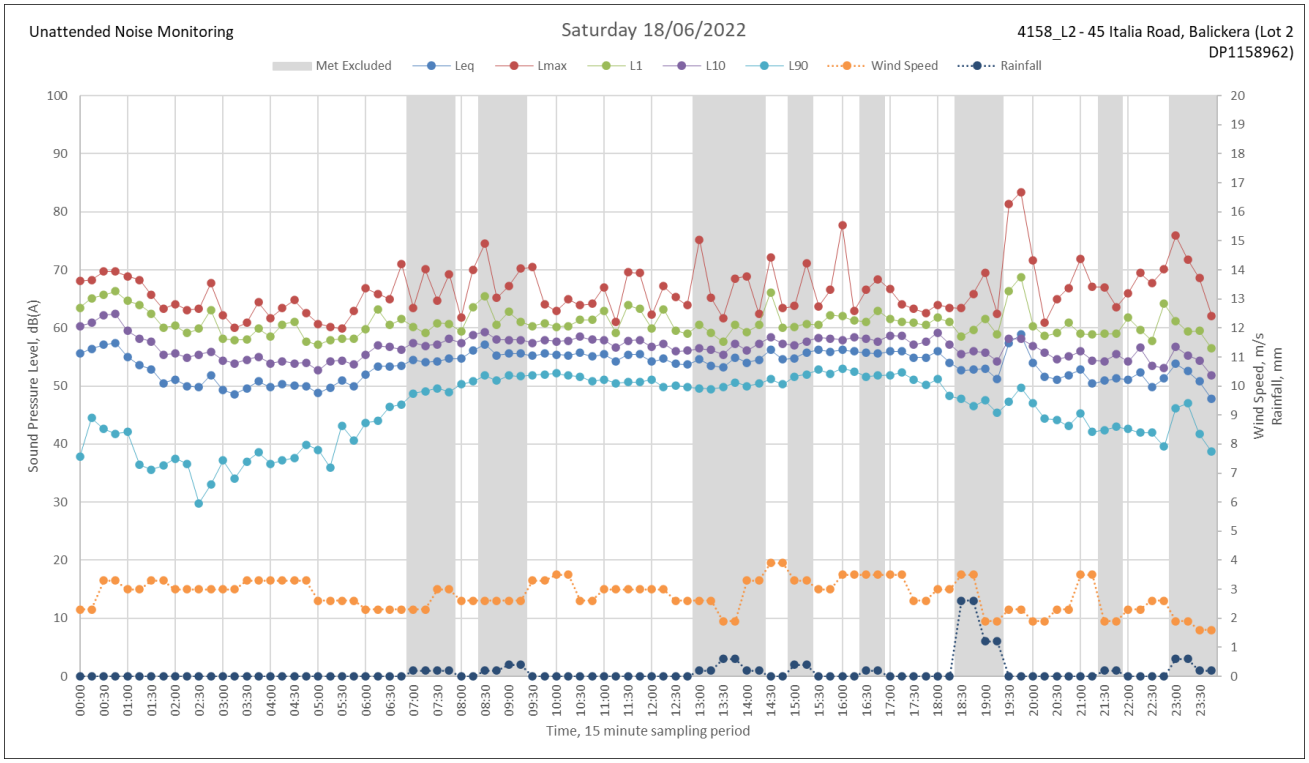


Figure B2.5 Unattended noise measurement at L2

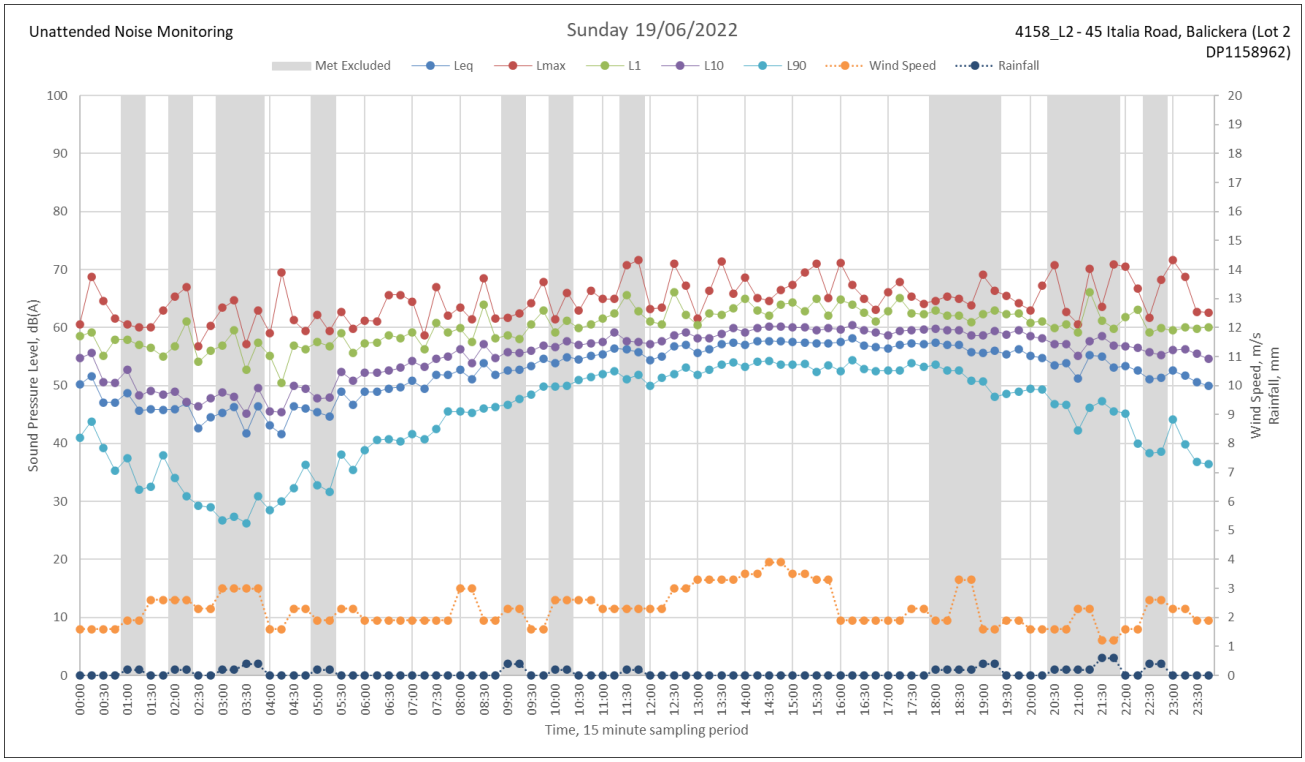


Figure B2.6 Unattended noise measurement at L2

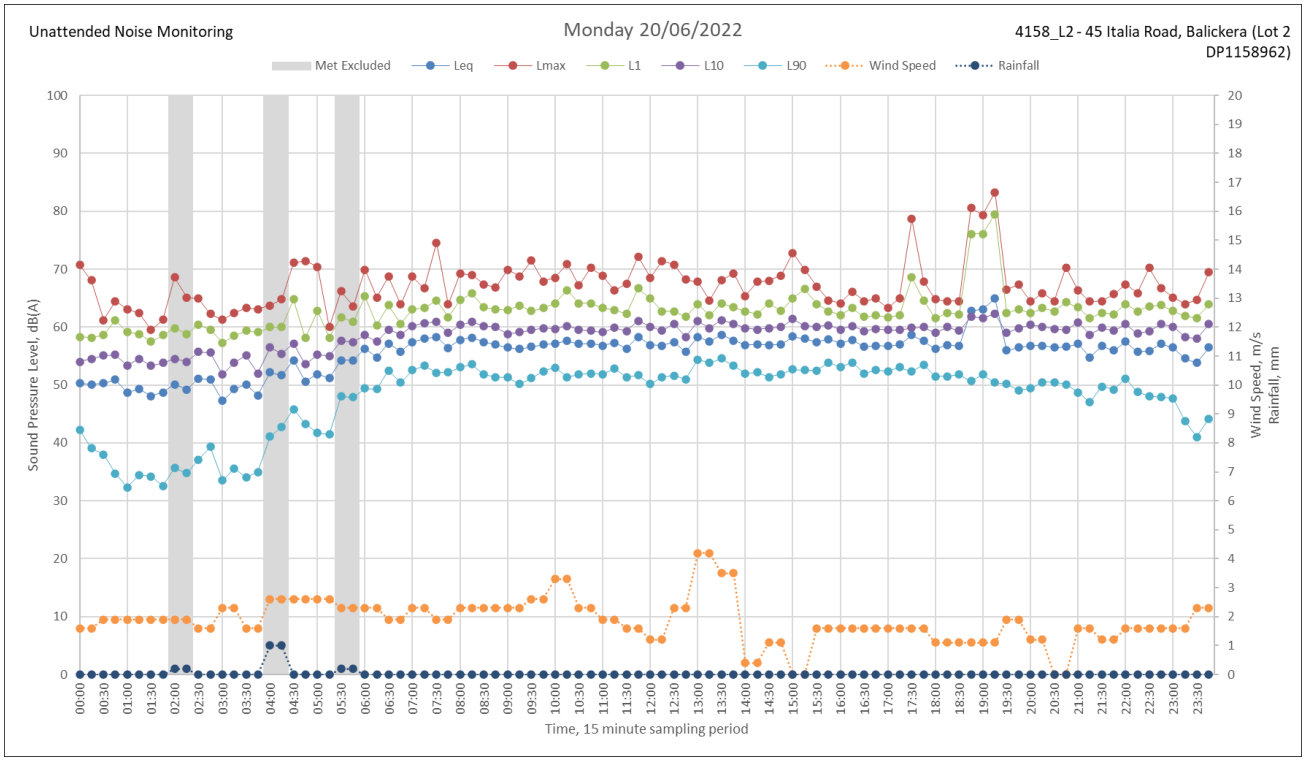


Figure B2.7 Unattended noise measurement at L2

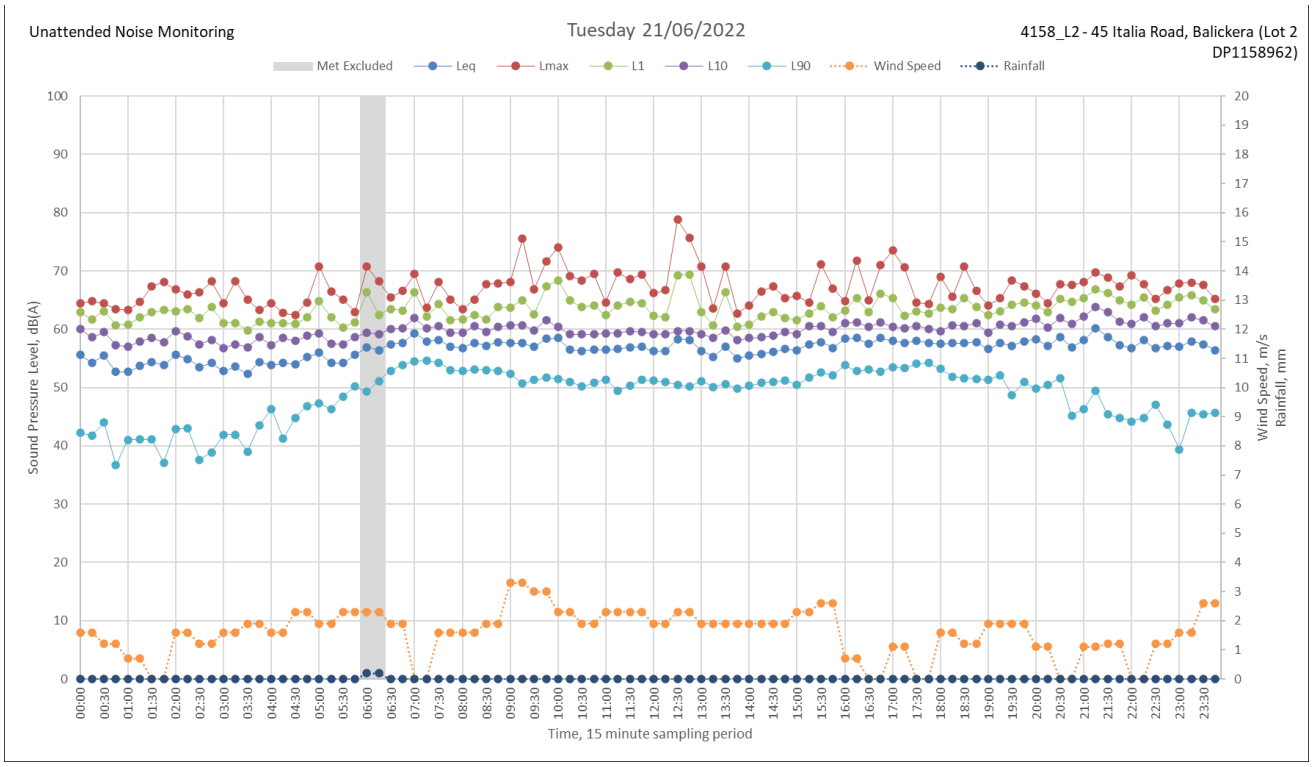


Figure B2.8 Unattended noise measurement at L2

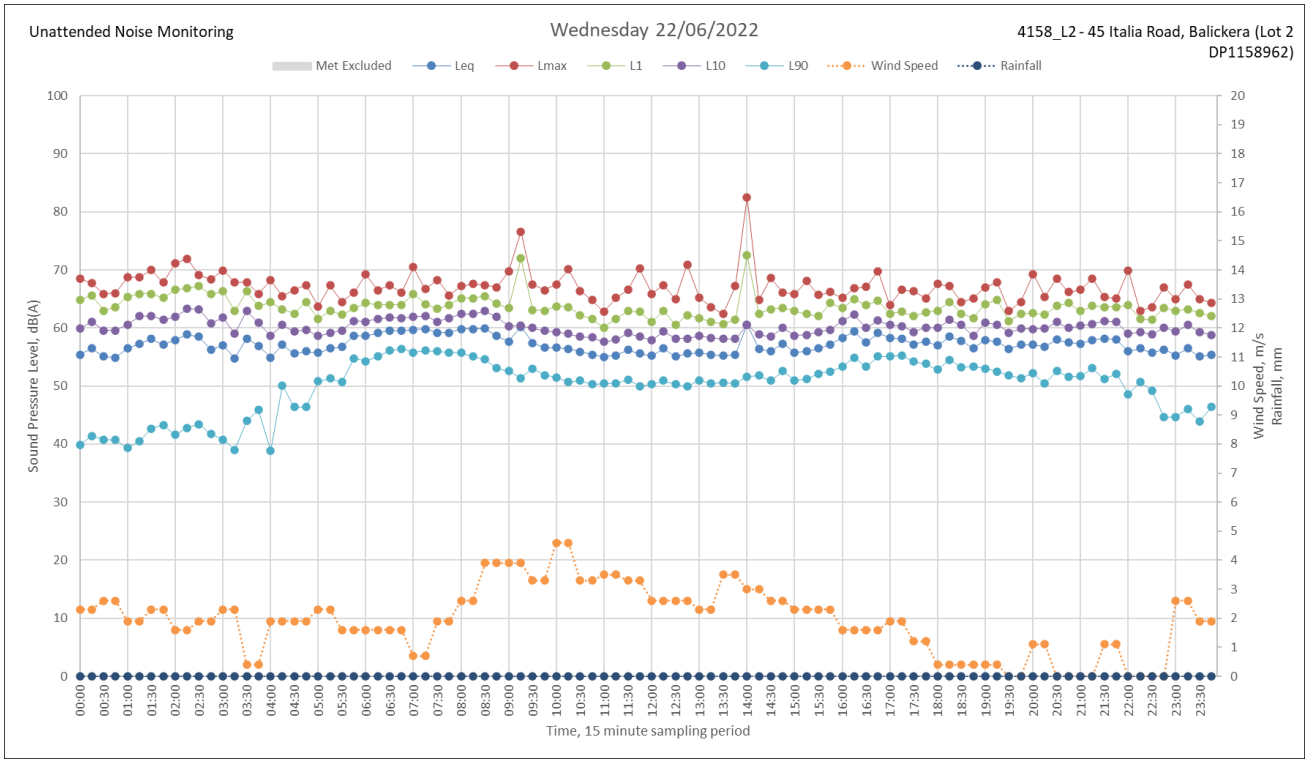


Figure B2.9 Unattended noise measurement at L2

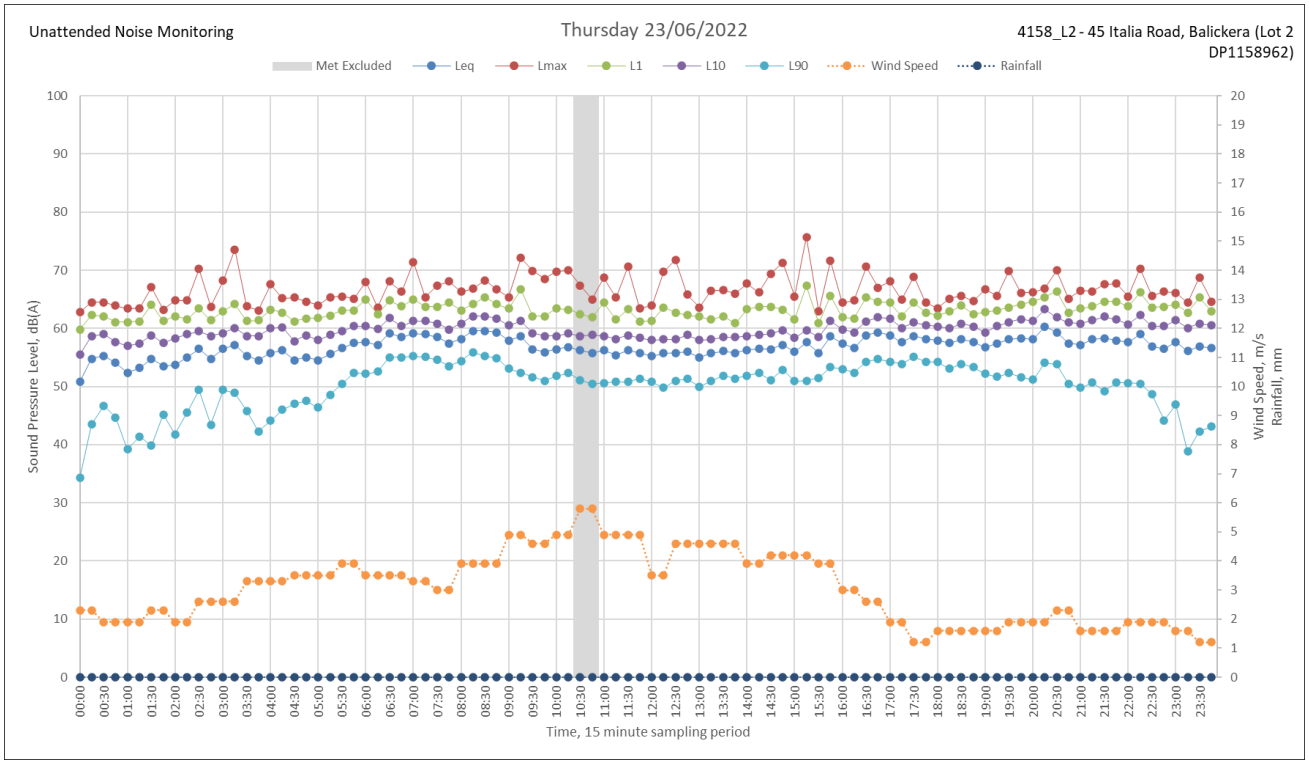


Figure B2.10 Unattended noise measurement at L2

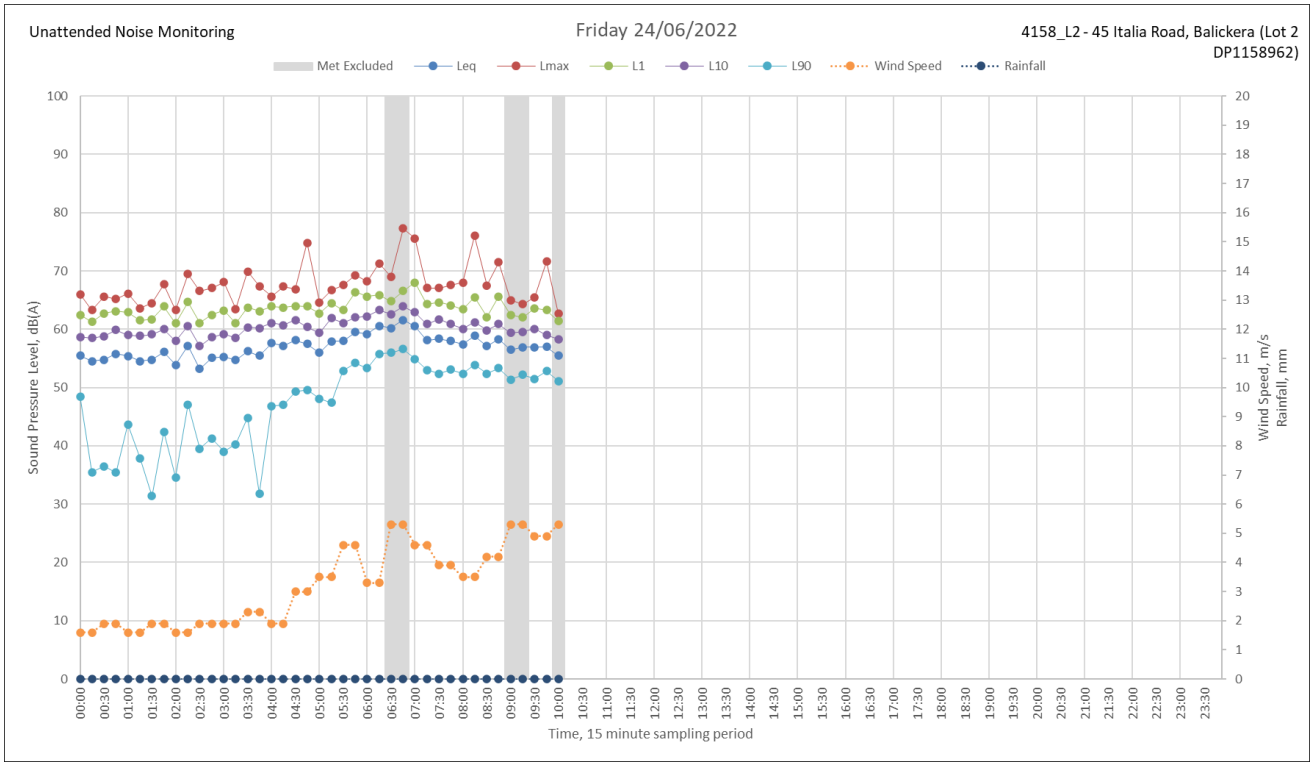


Figure B2.11 Unattended noise measurement at L2

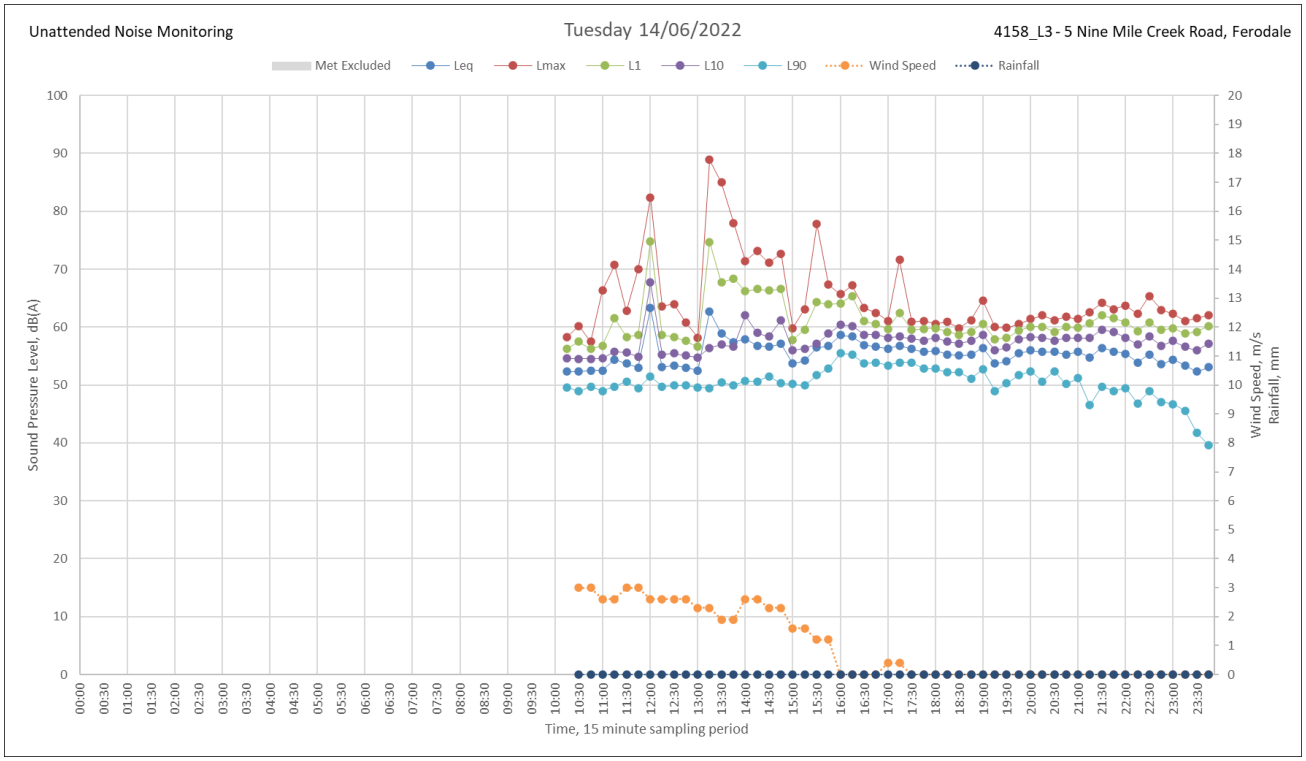


Figure B3.1 Unattended noise measurement at L3

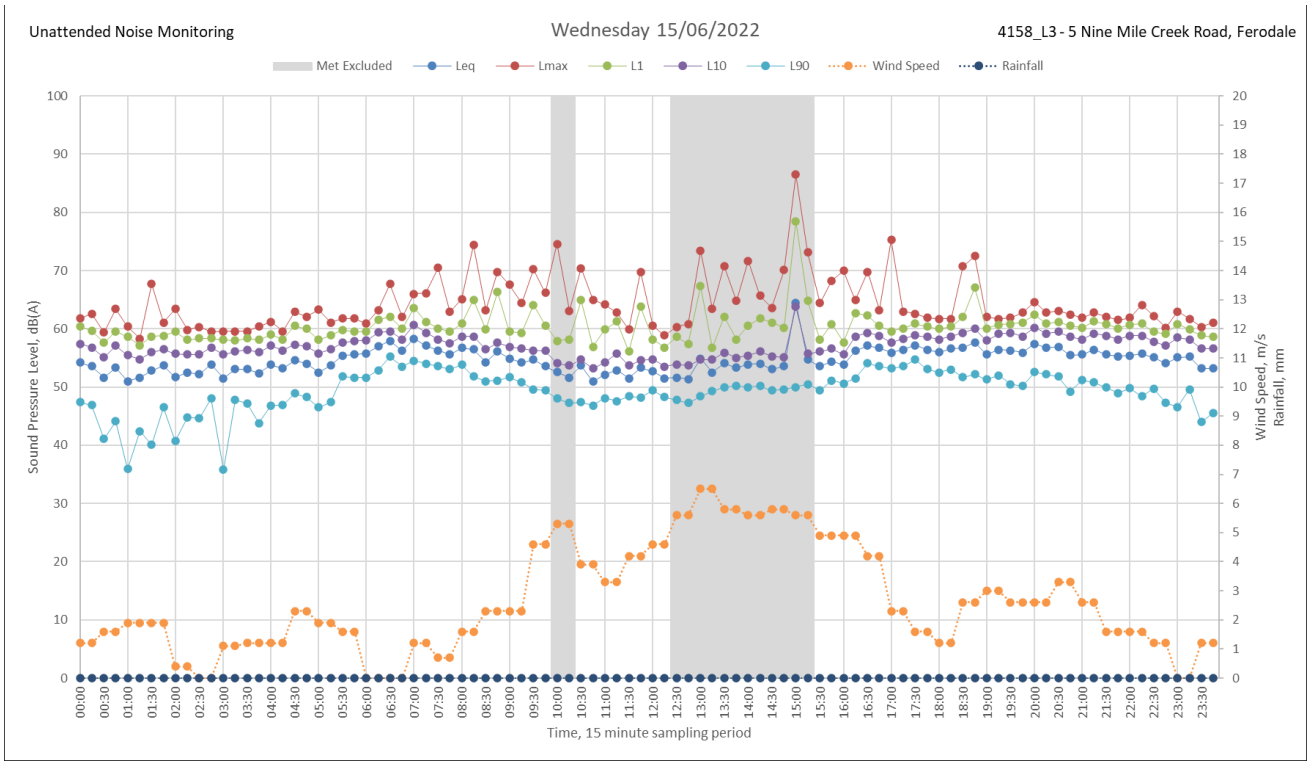


Figure B3.2 Unattended noise measurement at L3

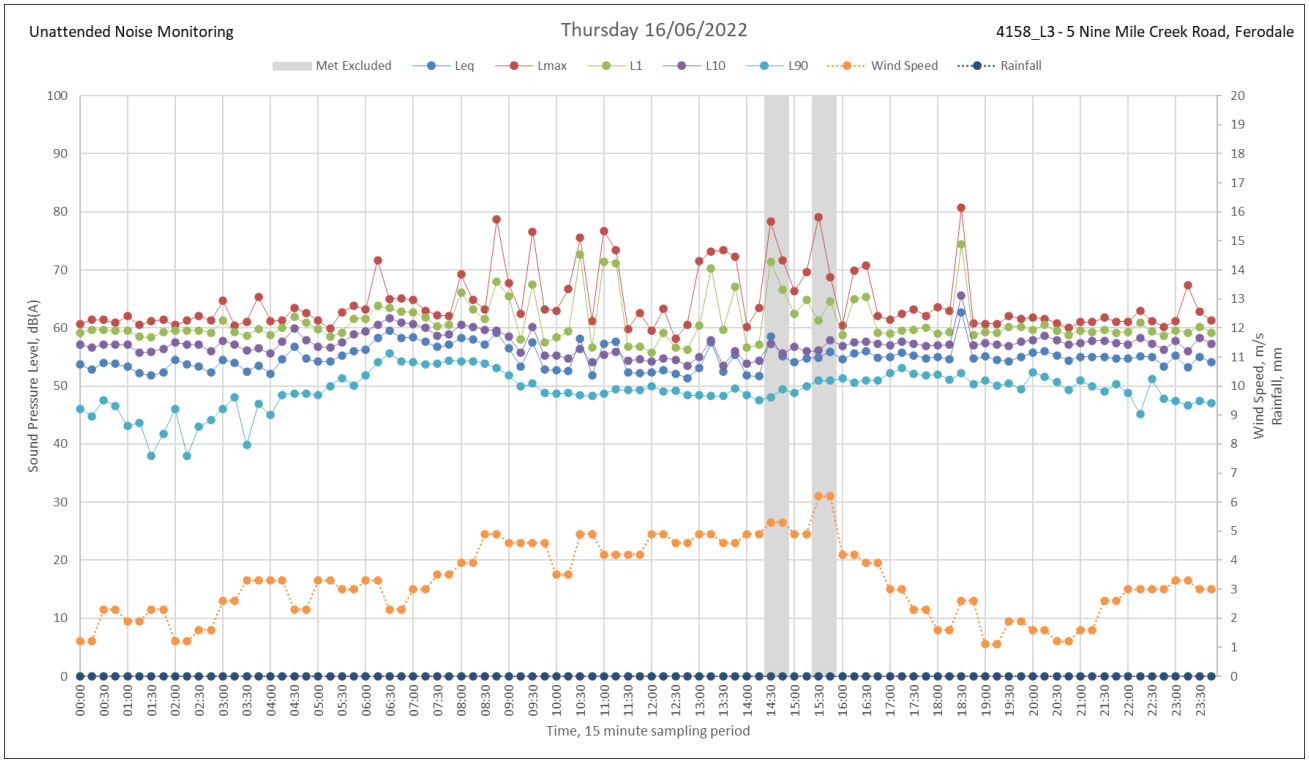


Figure B3.3 Unattended noise measurement at L3

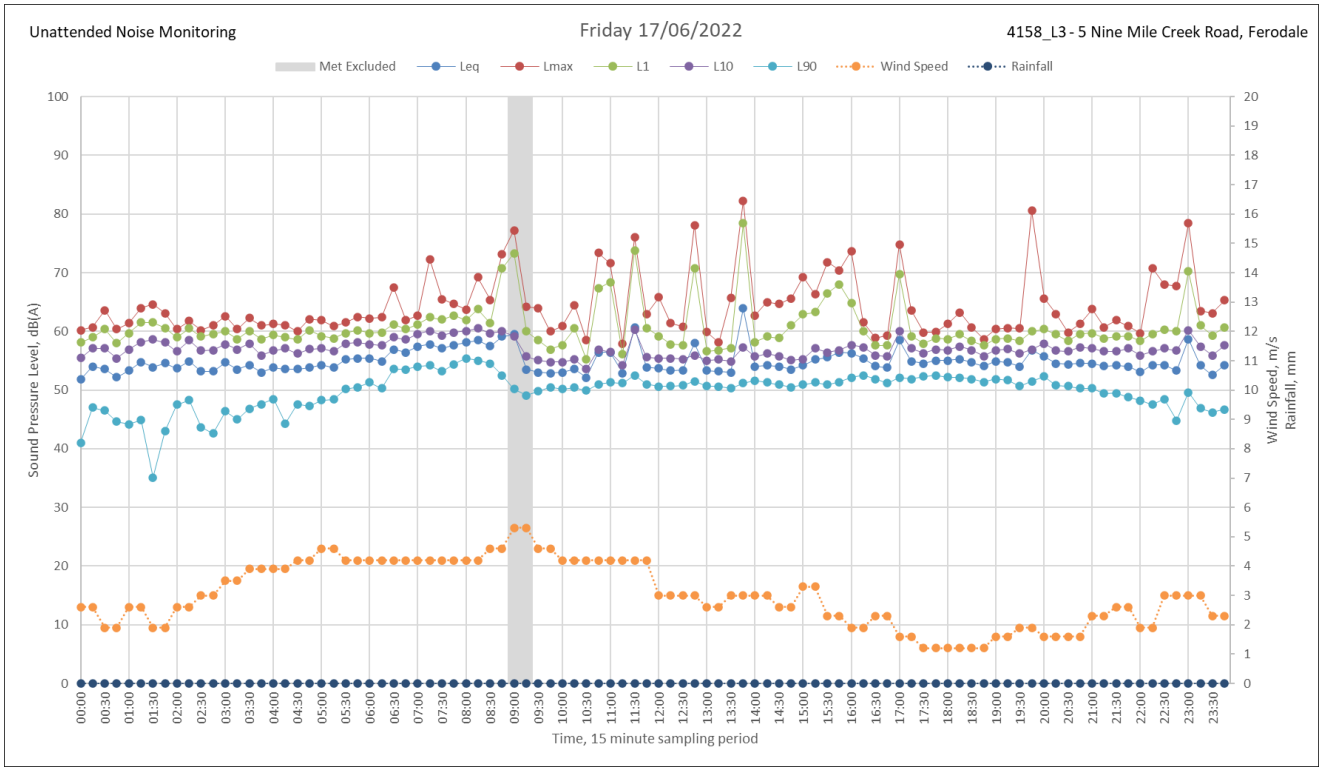


Figure B3.4 Unattended noise measurement at L3

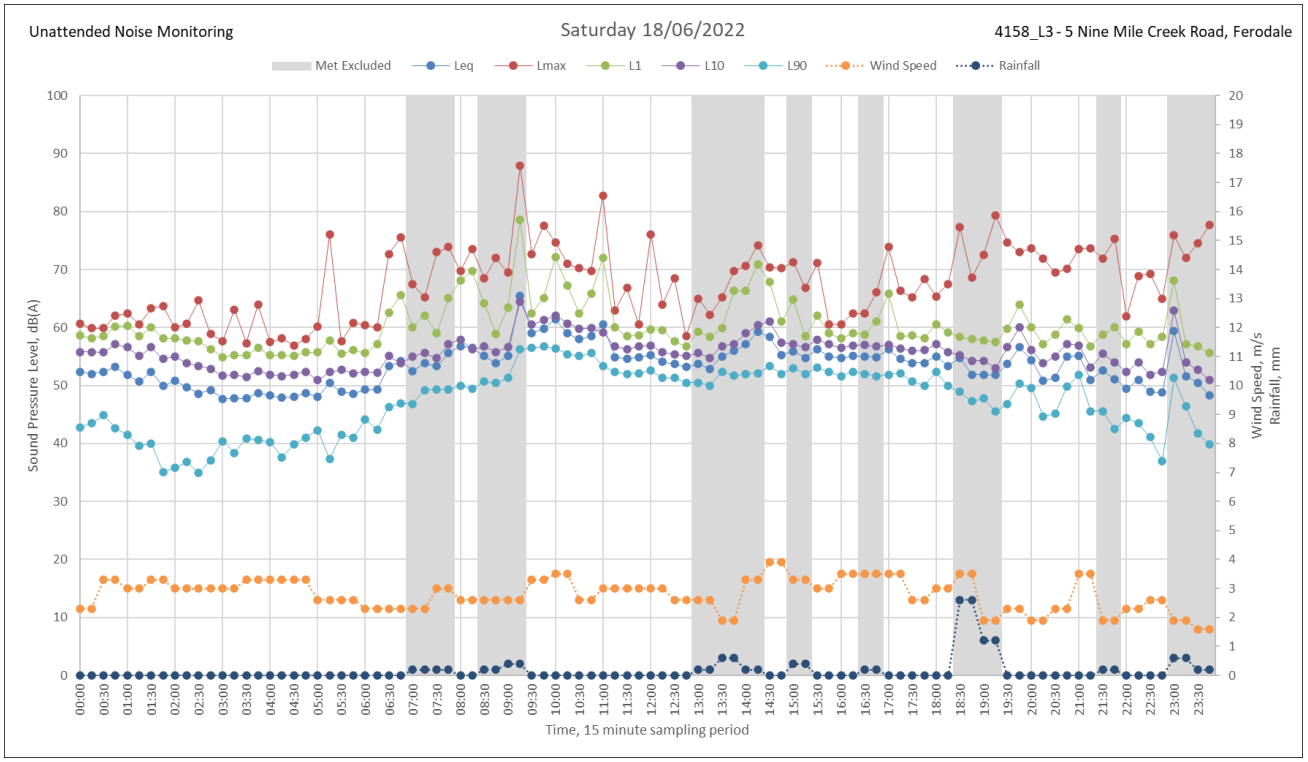


Figure B3.5 Unattended noise measurement at L3

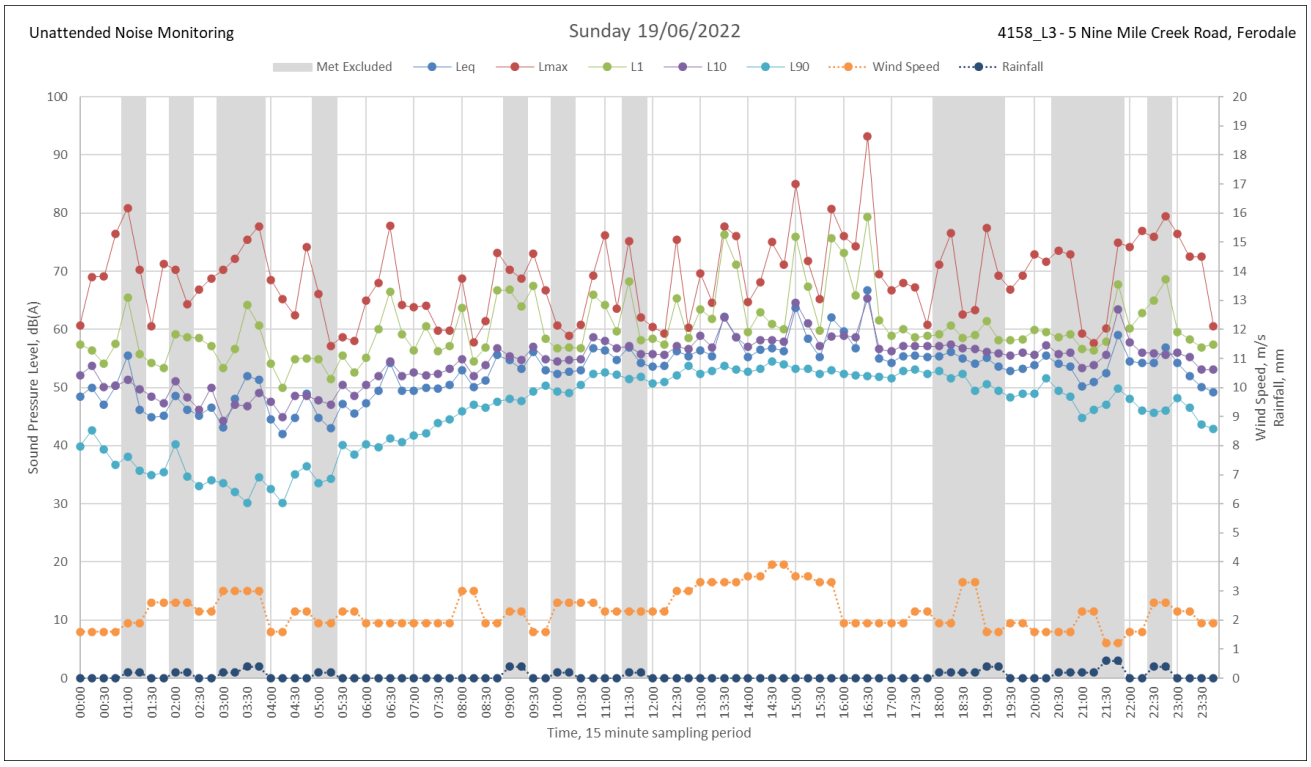


Figure B3.6 Unattended noise measurement at L3

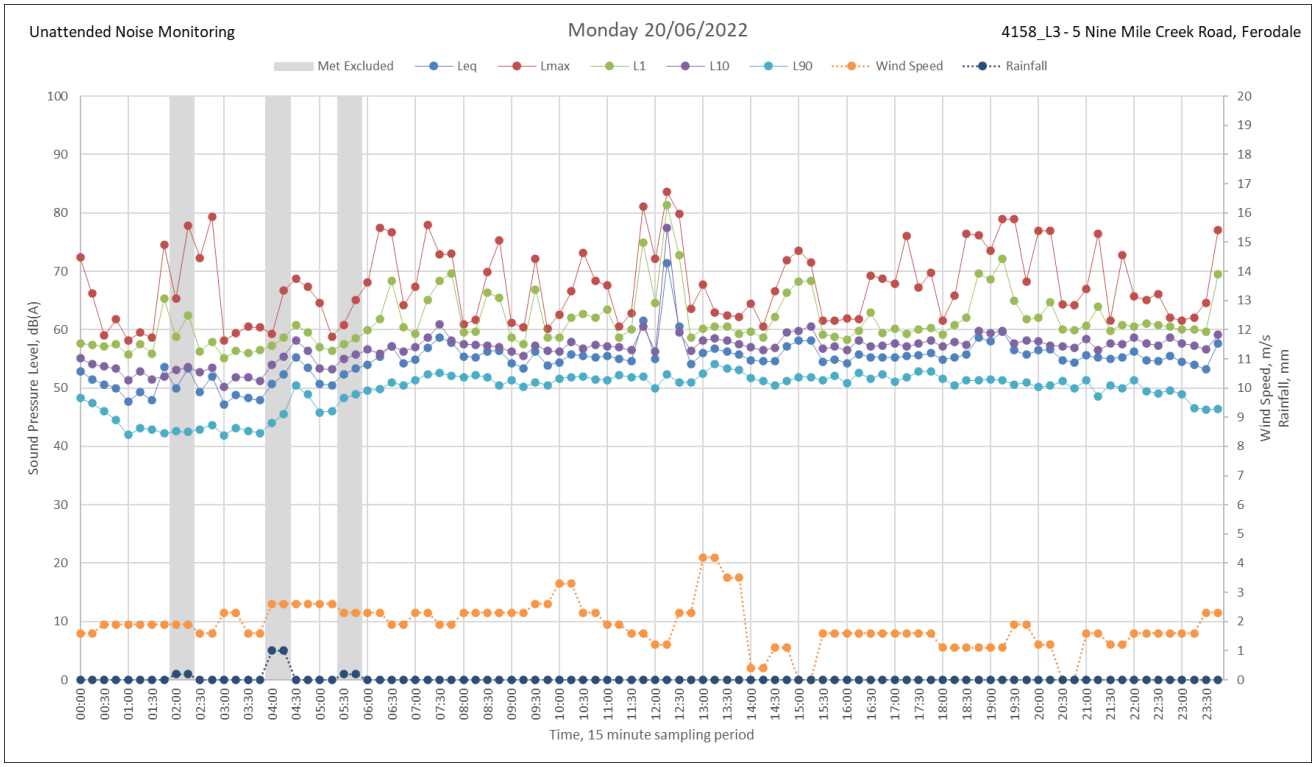


Figure B3.7 Unattended noise measurement at L3

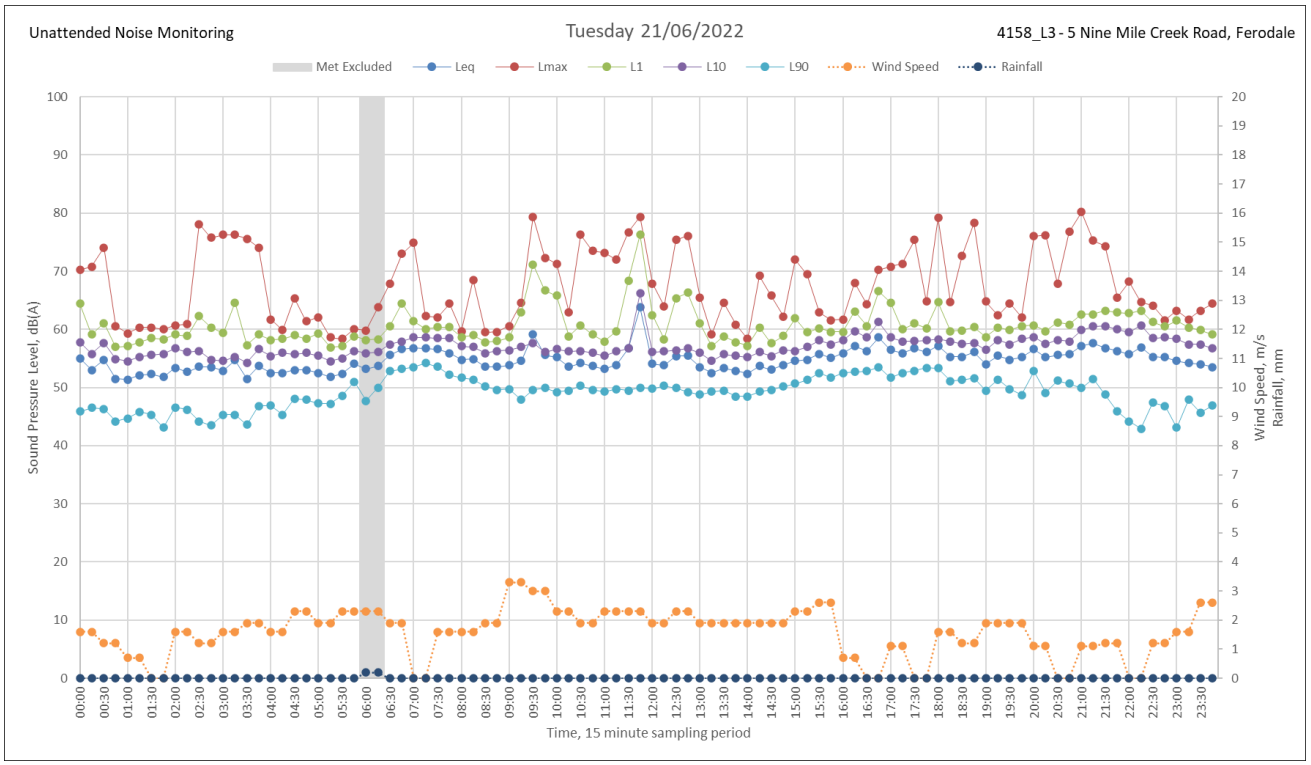


Figure B3.8 Unattended noise measurement at L3

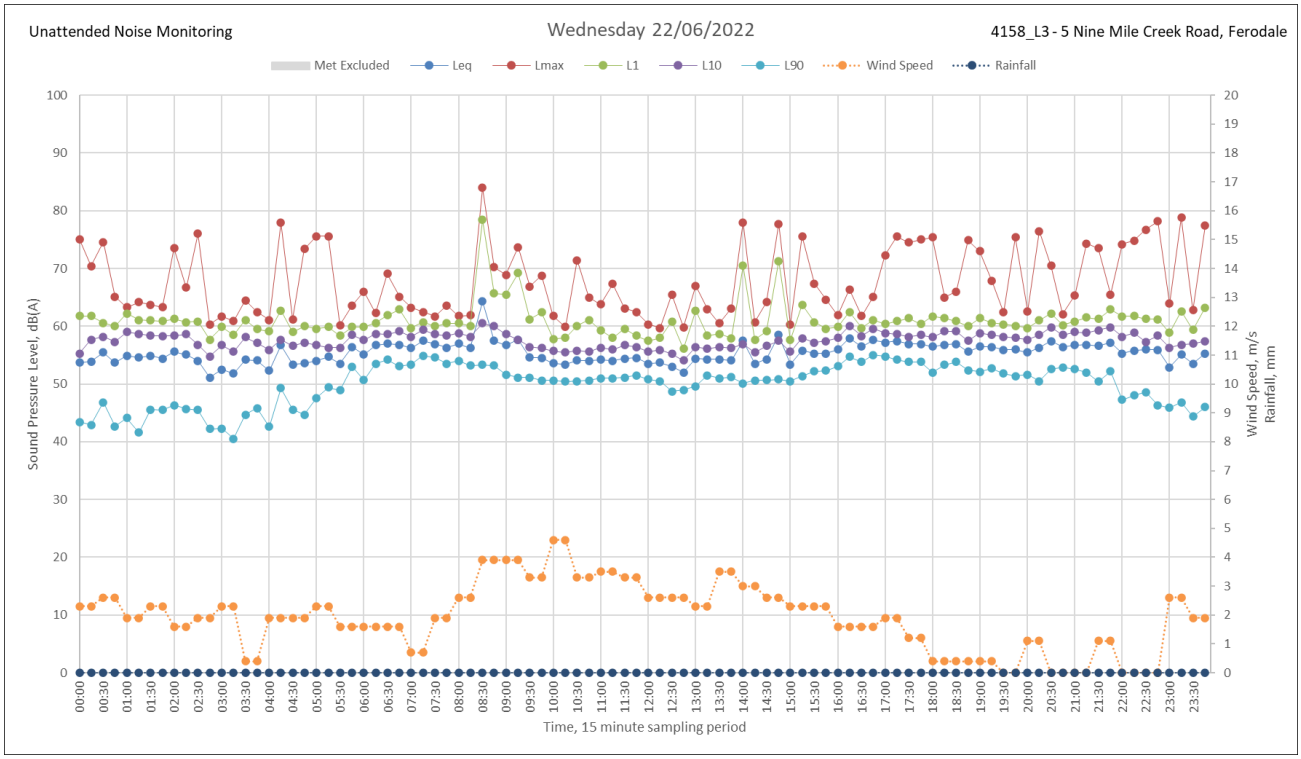


Figure B3.9 Unattended noise measurement at L3

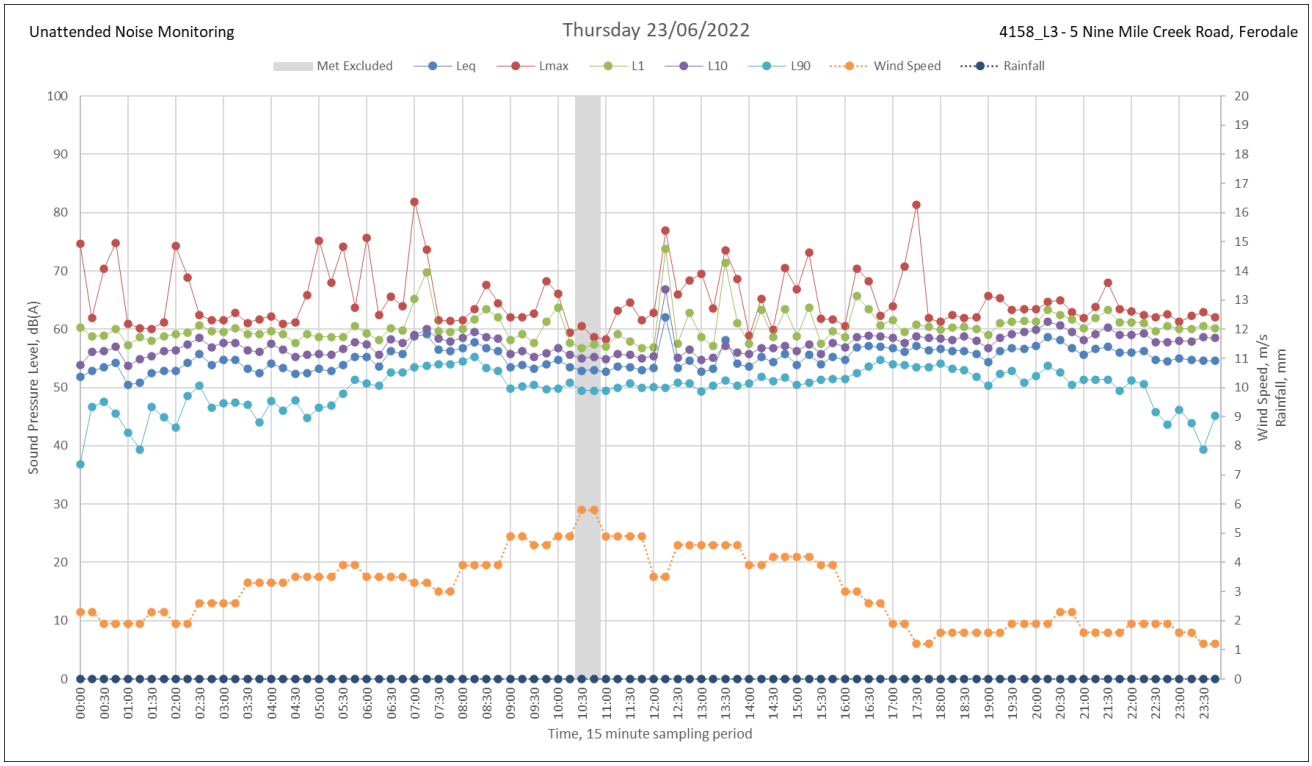


Figure B3.10 Unattended noise measurement at L3

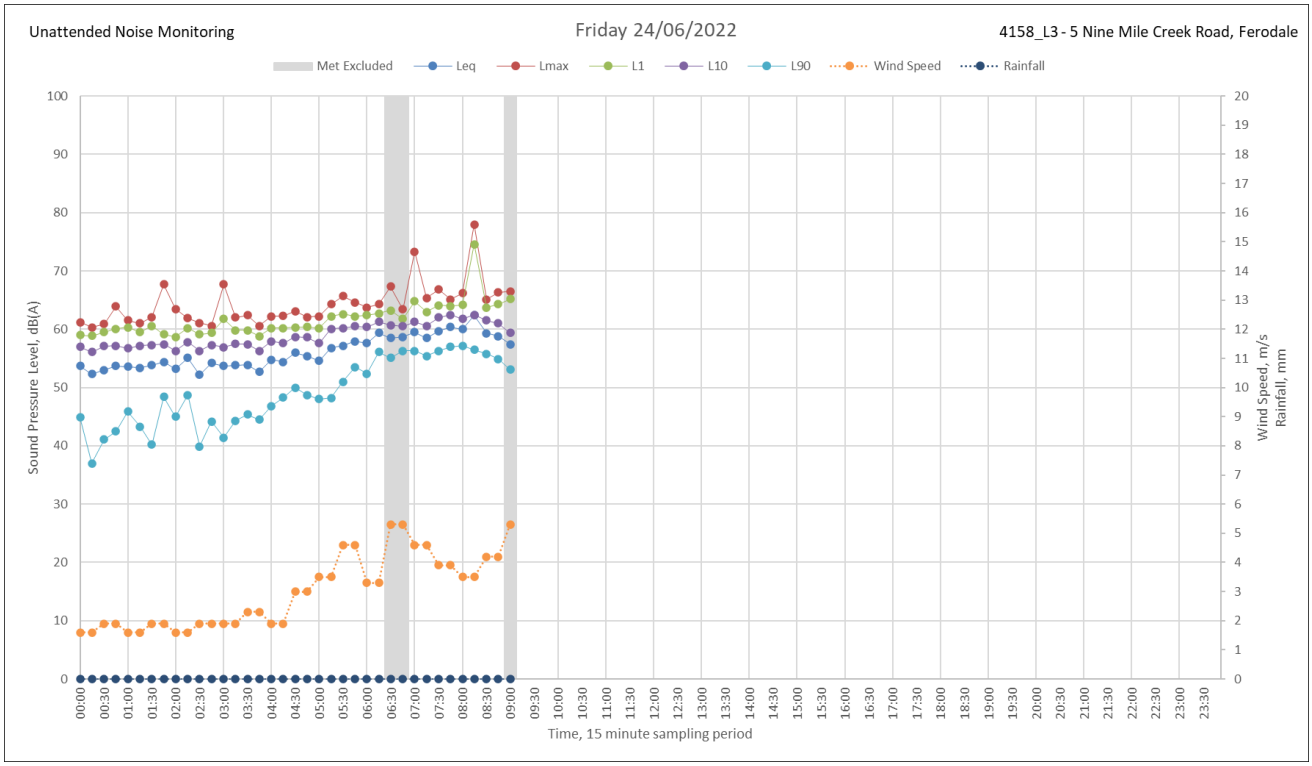
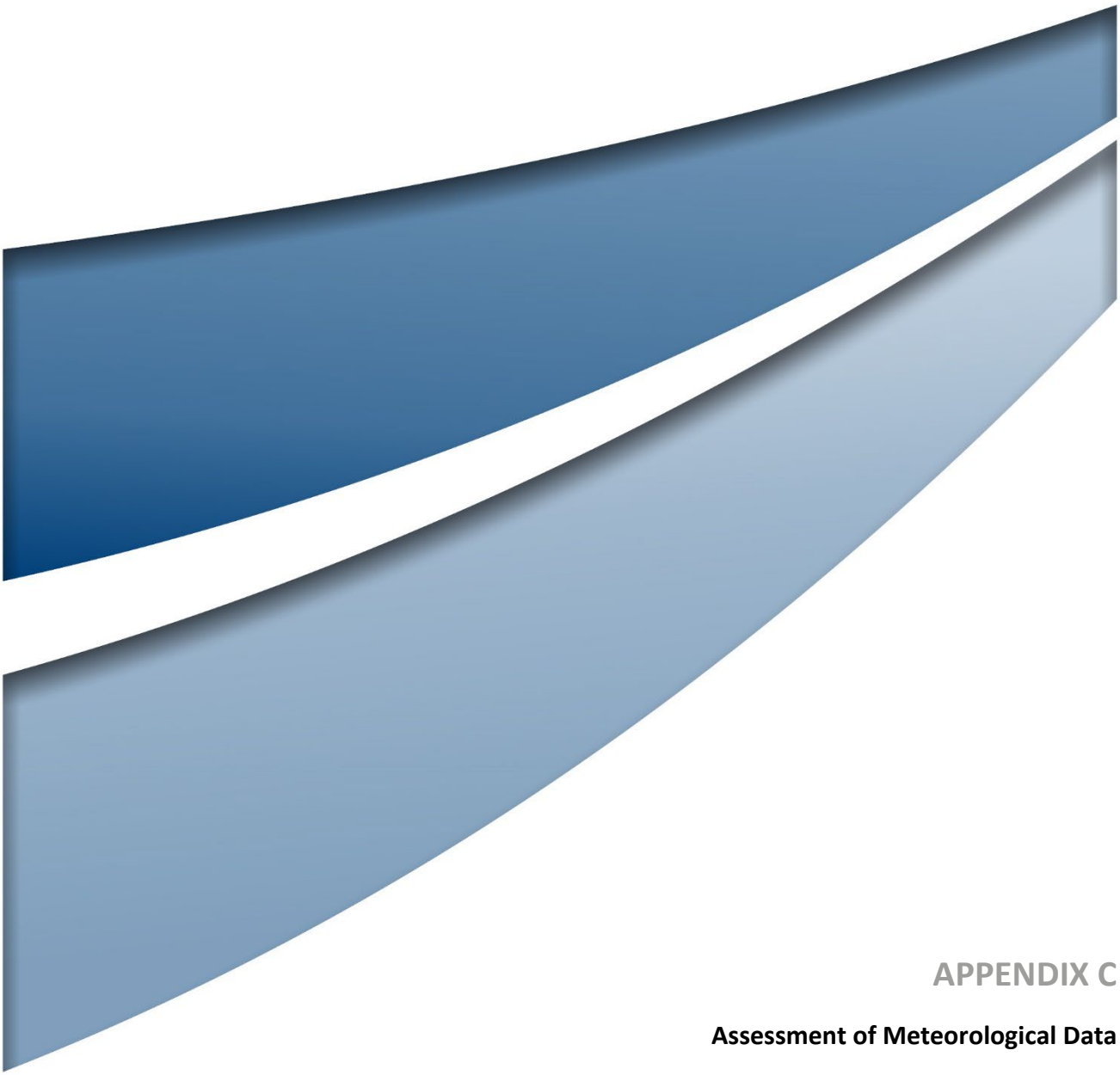


Figure B3.11 Unattended noise measurement at L3



APPENDIX C

Assessment of Meteorological Data

Appendix C – Assessment of Meteorological Conditions

Fact Sheet D of the *Noise Policy for Industry* (NPfI) (EPA, 2017) requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The NPfI notes that there are two approaches for the assessment of meteorological effects, such as gradient winds and temperature inversions, on propagating the noise from the source to the receiver. The simple method is to adopt the noise-enhancing meteorological conditions for all assessment periods outlined in the policies. Alternatively, local meteorological data can be used to determine weather conditions that would be expected to occur at a particular site for a significant period of time.

Hourly meteorological data from Beresfield (NSW Department of Planning Industry and Environment) and Williamtown (Bureau of Meteorology) for the years 2017 to 2021 was sourced. As part of the Air Quality Impact Assessment for this Project (Jacobs, 2022), the data sets from these 5 years were analysed for completeness and representativeness. The 2021 calendar year was identified as being most suitable for the assessment based on the data capture rate (i.e. greater than 90% complete) and containing representative meteorological conditions to other years considered.

The 2021 data set was analysed to determine the prevailing meteorological conditions (frequency of occurrence of prevailing winds and temperature inversions) for the area surrounding the Project.

Wind

The NPfI requires that wind effects be assessed when wind is considered a feature of the area. Wind is considered a feature of the area where source-to-receiver winds of 3 m/s occur for 30 per cent of the time in any assessment period. Fact Sheet D of the NPfI requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The collated meteorological data for the 2021 period, provided in **Tables C1** to **C4** and **Figures C1** to **C4**, was analysed to determine prevailing wind conditions likely to influence the propagation of noise at the Project site.

Table C1 Prevailing Wind Analysis, Summer

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
Day							
N	0.3%	-	0.1%	3.4%	2.8%	0.3%	-
NE		-	0.4%	2.5%	6.0%	2.2%	0.5%
E		-	0.3%	1.1%	8.0%	6.1%	2.2%
SE		-	0.1%	2.2%	8.0%	10.6%	5.9%
S		-	0.1%	1.3%	4.4%	7.3%	9.7%
SW		-	0.2%	0.8%	1.1%	0.7%	0.7%
W		-	0.5%	0.6%	1.2%	0.8%	0.7%
NW		-	0.1%	2.6%	2.0%	1.0%	1.0%
Evening							
N	5.0%	0.8%	0.8%	2.8%	1.4%	-	-
NE		-	0.3%	8.3%	11.9%	2.5%	0.3%

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
E		0.8%	5.8%	8.6%	3.6%	0.8%	-
SE		0.3%	1.1%	5.3%	6.4%	2.5%	0.8%
S		0.3%	0.8%	3.6%	6.4%	5.6%	4.4%
SW		-	-	1.7%	1.1%	0.8%	0.3%
W		-	0.8%	0.3%	0.3%	-	-
NW		0.8%	0.3%	1.4%	0.8%	-	-
Night							
N	13.9%	1.4%	1.1%	1.8%	0.1%	-	-
NE		-	2.0%	6.7%	2.6%	-	-
E		1.0%	3.6%	3.3%	1.1%	0.1%	-
SE		0.4%	0.6%	3.2%	3.6%	1.5%	0.5%
S		0.6%	0.7%	3.7%	5.7%	4.6%	2.7%
SW		-	0.4%	3.8%	3.0%	1.0%	0.2%
W		0.7%	2.1%	7.5%	3.2%	0.5%	0.1%
NW		0.7%	3.7%	4.9%	1.5%	0.1%	-

Table C2 Prevailing Wind Analysis, Autumn

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
Day							
N	1.8%	-	0.7%	2.2%	0.8%	0.2%	-
NE		-	0.4%	2.5%	3.3%	0.9%	0.1%
E		0.3%	0.4%	3.2%	4.0%	2.6%	0.4%
SE		0.1%	0.6%	5.2%	5.8%	3.2%	1.1%
S		0.3%	1.0%	2.3%	3.7%	3.6%	3.0%
SW		0.2%	0.5%	2.3%	1.8%	1.1%	0.7%
W		0.3%	0.6%	4.1%	4.2%	4.1%	6.7%
NW		0.1%	1.1%	5.1%	7.7%	3.2%	3.2%
Evening							
N	19.8%	1.1%	1.6%	3.5%	0.8%	-	-
NE		-	0.5%	5.2%	3.3%	0.5%	-
E		1.4%	4.3%	4.1%	1.6%	0.5%	-
SE		0.5%	1.9%	3.0%	3.8%	-	0.8%
S		0.3%	-	1.6%	1.9%	1.1%	0.5%
SW		-	1.1%	1.9%	2.7%	1.9%	0.3%
W		1.1%	3.5%	4.9%	4.1%	1.9%	-
NW		1.1%	3.8%	5.4%	2.4%	-	-
Night							
N	14.1%	1.0%	0.6%	0.4%	0.1%	-	-
NE		-	0.6%	1.0%	0.6%	-	-

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
E		0.5%	1.4%	3.4%	1.2%	1.0%	-
SE		0.4%	0.5%	1.0%	1.3%	0.6%	0.5%
S		-	0.2%	0.7%	0.8%	0.1%	0.2%
SW		0.2%	1.0%	2.1%	2.2%	1.1%	-
W		1.3%	3.6%	15.8%	6.5%	3.4%	2.9%
NW		1.0%	4.3%	11.0%	10.3%	1.0%	0.1%

Table C3 Prevailing Wind Analysis, Winter

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
Day							
N	4.2%	0.3%	1.2%	5.0%	1.5%	0.1%	-
NE		0.1%	0.3%	3.3%	1.6%	0.5%	-
E		0.2%	0.9%	1.8%	1.8%	0.1%	-
SE		-	0.4%	1.8%	1.6%	0.1%	-
S		0.1%	0.3%	1.0%	0.7%	0.5%	0.2%
SW		0.1%	0.5%	0.8%	1.4%	1.2%	2.1%
W		0.1%	1.0%	2.6%	5.5%	4.6%	15.7%
NW		0.5%	1.9%	8.5%	10.7%	4.2%	9.3%
Evening							
N	19.6%	4.1%	2.7%	1.4%	0.3%	-	-
NE		-	0.3%	3.8%	0.3%	-	-
E		1.4%	3.5%	1.9%	-	-	-
SE		-	-	-	-	-	-
S		0.3%	0.3%	0.3%	0.3%	-	-
SW		0.3%	-	-	1.9%	0.3%	1.1%
W		0.8%	2.7%	4.6%	6.3%	2.2%	10.6%
NW		2.4%	4.9%	8.2%	6.3%	3.5%	3.8%
Night							
N	13.9%	1.1%	0.7%	1.6%	0.4%	-	-
NE		-	0.5%	0.7%	0.4%	-	-
E		0.4%	0.2%	-	-	-	-
SE		-	-	0.1%	0.1%	-	-
S		-	0.1%	-	-	0.4%	-
SW		-	0.2%	0.2%	1.0%	0.4%	0.8%
W		2.4%	1.9%	8.8%	8.7%	8.3%	11.8%
NW		1.8%	3.6%	11.0%	13.0%	1.4%	3.9%

Table C4 Prevailing Wind Analysis, Spring

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
Day							
N	0.5%	-	0.3%	3.4%	2.4%	0.1%	-
NE		-	-	2.1%	5.6%	4.8%	1.4%
E		-	0.4%	2.2%	4.6%	3.5%	0.9%
SE		0.1%	0.3%	2.3%	5.4%	6.5%	2.4%
S		0.1%	0.3%	1.3%	2.3%	3.4%	5.7%
SW		-	-	0.5%	1.2%	1.0%	1.1%
W		0.1%	0.2%	1.3%	1.7%	2.7%	8.6%
NW		0.1%	0.6%	3.4%	3.1%	2.8%	9.4%
Evening							
N	8.2%	1.6%	1.6%	1.6%	0.5%	-	-
NE		0.3%	1.1%	8.5%	10.2%	0.8%	-
E		1.4%	4.7%	6.3%	0.8%	0.3%	0.3%
SE		-	0.3%	4.1%	4.7%	1.6%	0.8%
S		-	0.5%	1.9%	3.0%	3.3%	3.0%
SW		0.3%	-	2.2%	1.1%	0.8%	-
W		-	0.5%	1.6%	5.8%	1.9%	4.4%
NW		-	1.6%	2.2%	1.9%	1.4%	2.5%
Night							
N	14.3%	0.5%	2.0%	2.0%	0.4%	-	-
NE		-	1.6%	4.2%	1.2%	-	-
E		0.5%	2.8%	4.4%	0.2%	-	-
SE		0.2%	1.3%	1.5%	1.6%	1.3%	0.6%
S		0.1%	0.1%	2.6%	2.3%	1.1%	2.3%
SW		0.1%	0.2%	2.2%	2.1%	0.4%	0.1%
W		0.6%	2.3%	8.1%	7.2%	2.3%	5.0%
NW		1.5%	5.0%	7.3%	3.4%	1.2%	1.8%

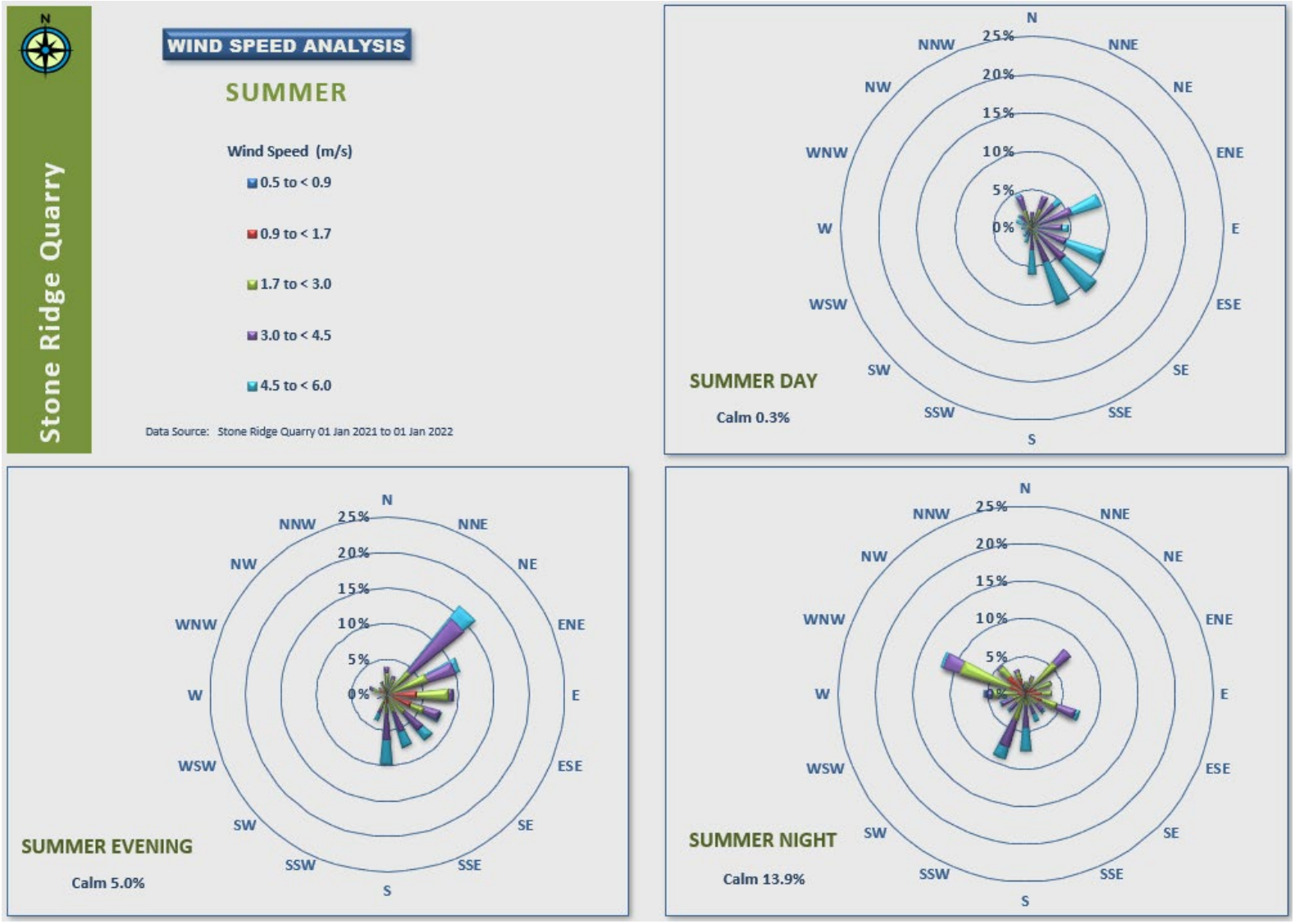


Figure C1 Wind Speed Analysis, Summer

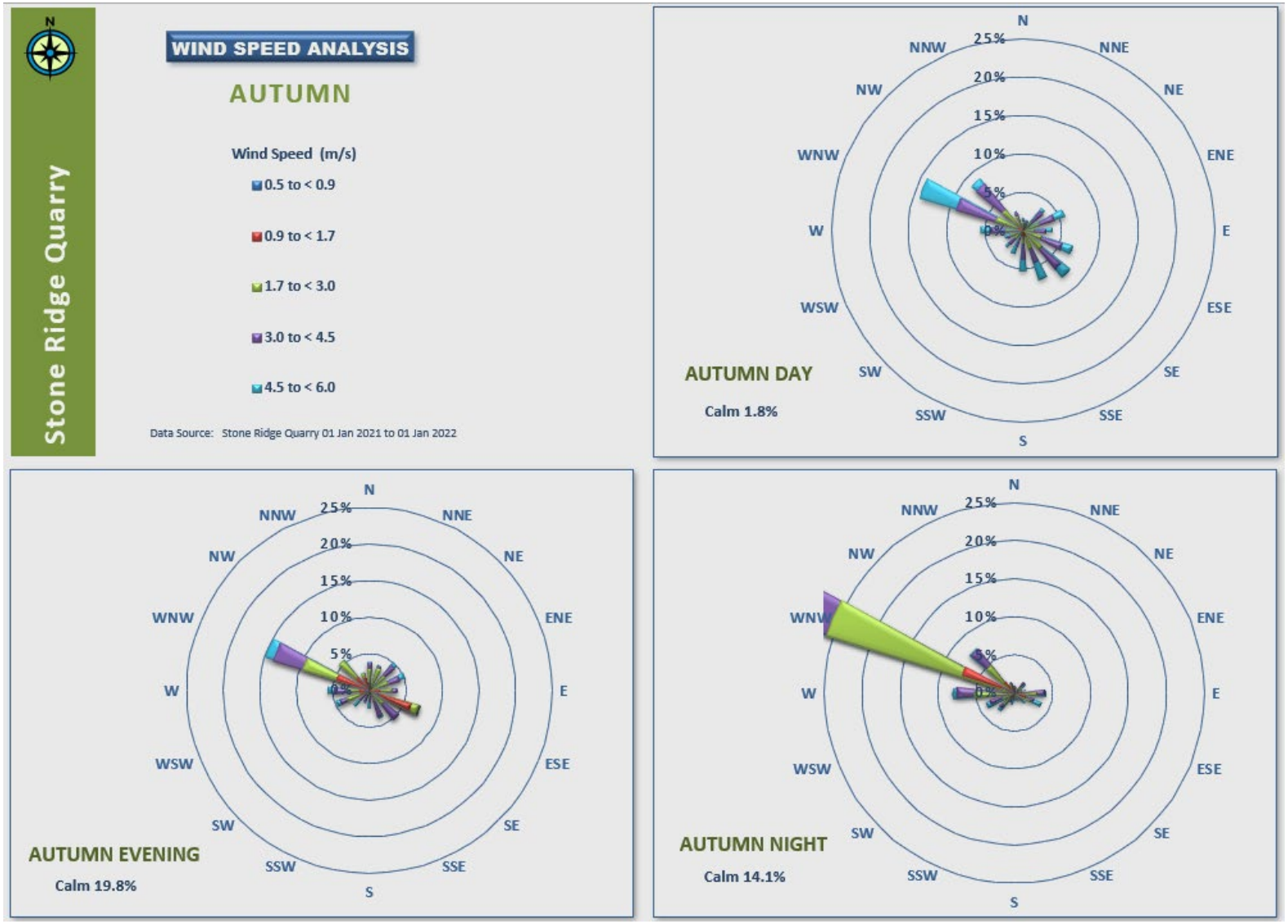


Figure C2 Wind Speed Analysis, Autumn

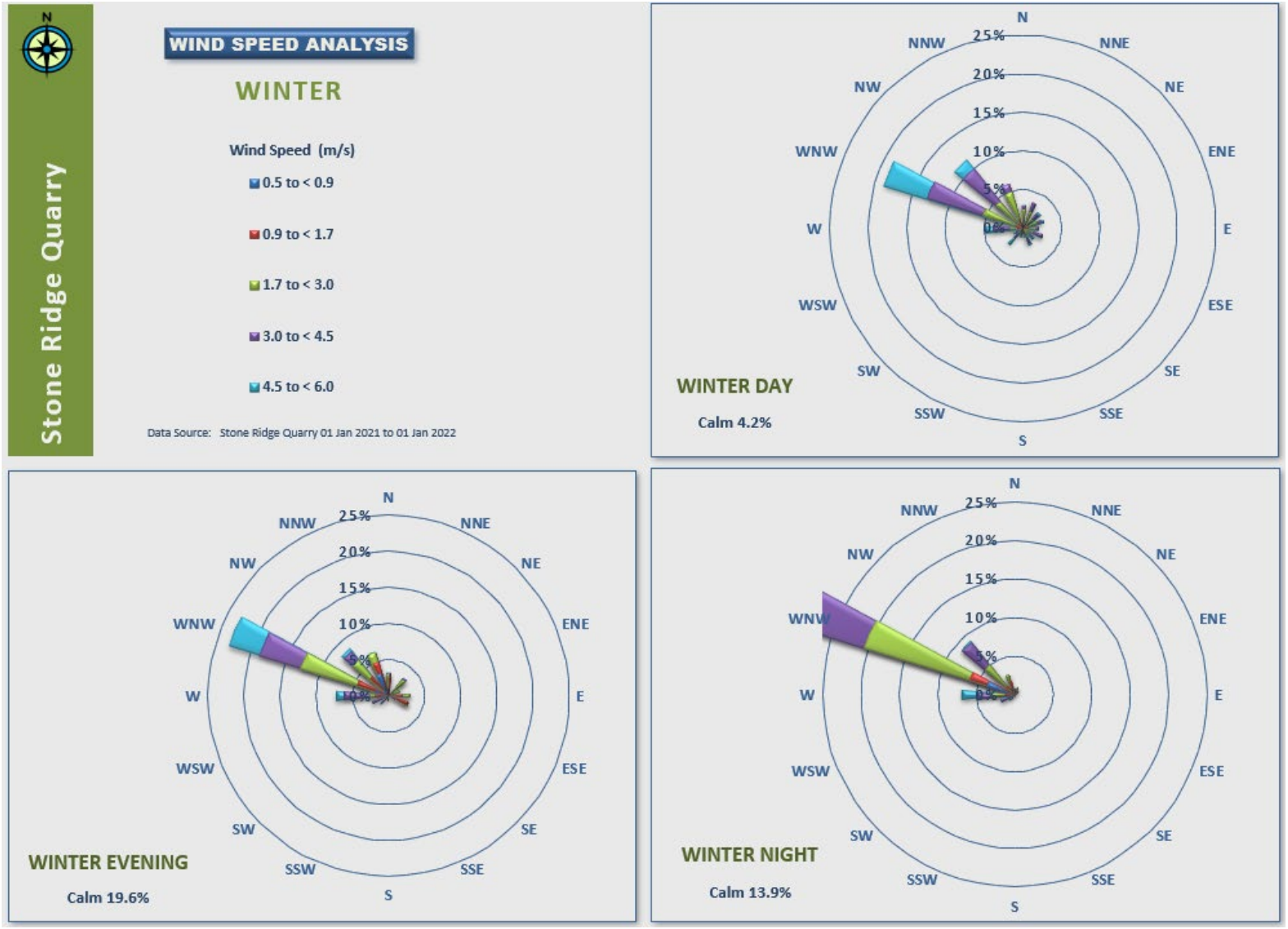


Figure C3 Wind Speed Analysis, Winter

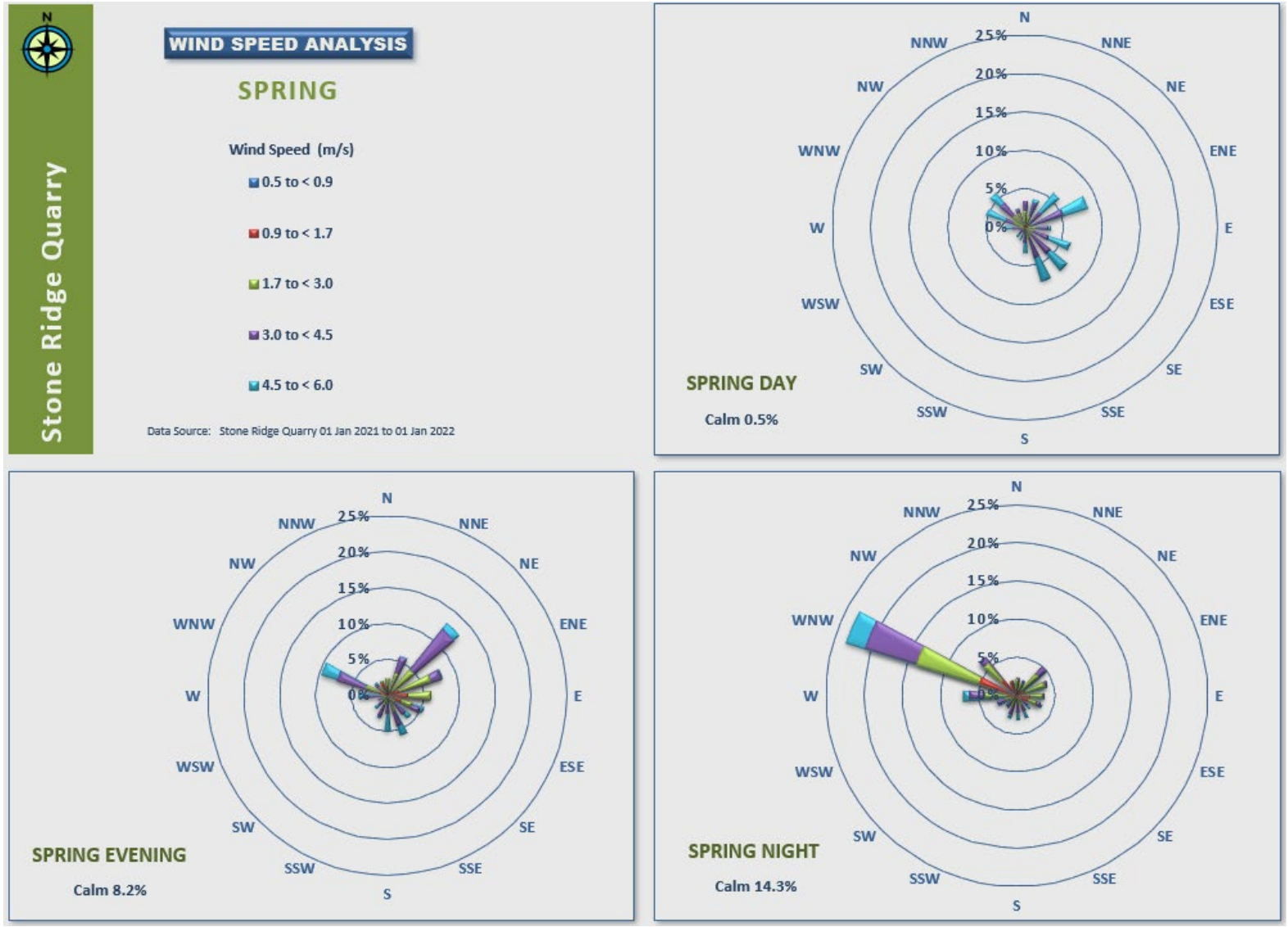


Figure C4 Wind Speed Analysis, Spring

Temperature Inversions

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30 per cent of the total night time (i.e. the evening and night-time periods) during winter months or about two nights per week.

Meteorological data was assessed in accordance with NPFI methodology to determine the likelihood of temperature inversions during the winter evening and night time periods. The results of the analysis of the meteorological data for 2021 are presented in **Table C5** and **Figure C5**.

Table C5 Stability Class Wind Analysis, Winter Evening and Night (6.00 pm to 7.00 am)

	< 0.5	0.5 to < 0.9	0.9 to < 1.7	1.7 to < 3.0	3.0 to < 4.5	4.5 to < 6.0	> 6.0
Inversion Conditions							
N	15.1%	1.4%	1.4%	1.7%	0.2%	-	-
NE		-	0.8%	2.0%	0.1%	-	-
E		0.6%	1.7%	0.8%	-	-	-
SE		0.1%	0.2%	0.3%	0.1%	-	-
S		0.1%	0.2%	0.1%	0.1%	-	-
SW		0.1%	0.3%	0.8%	0.6%	-	-
W		1.5%	2.4%	8.3%	2.7%	-	-
NW		1.5%	4.0%	9.8%	4.0%	-	-
Non-Inversion Conditions							
N	-%	-	-	0.1%	0.3%	-	-
NE		-	-	-	0.8%	0.1%	-
E		-	-	0.1%	-	-	-
SE		-	-	-	0.4%	0.3%	-
S		-	-	-	0.6%	0.8%	0.2%
SW		-	-	0.1%	1.7%	1.2%	0.7%
W		-	-	0.2%	6.3%	5.2%	8.7%
NW		-	-	-	5.8%	1.5%	2.5%

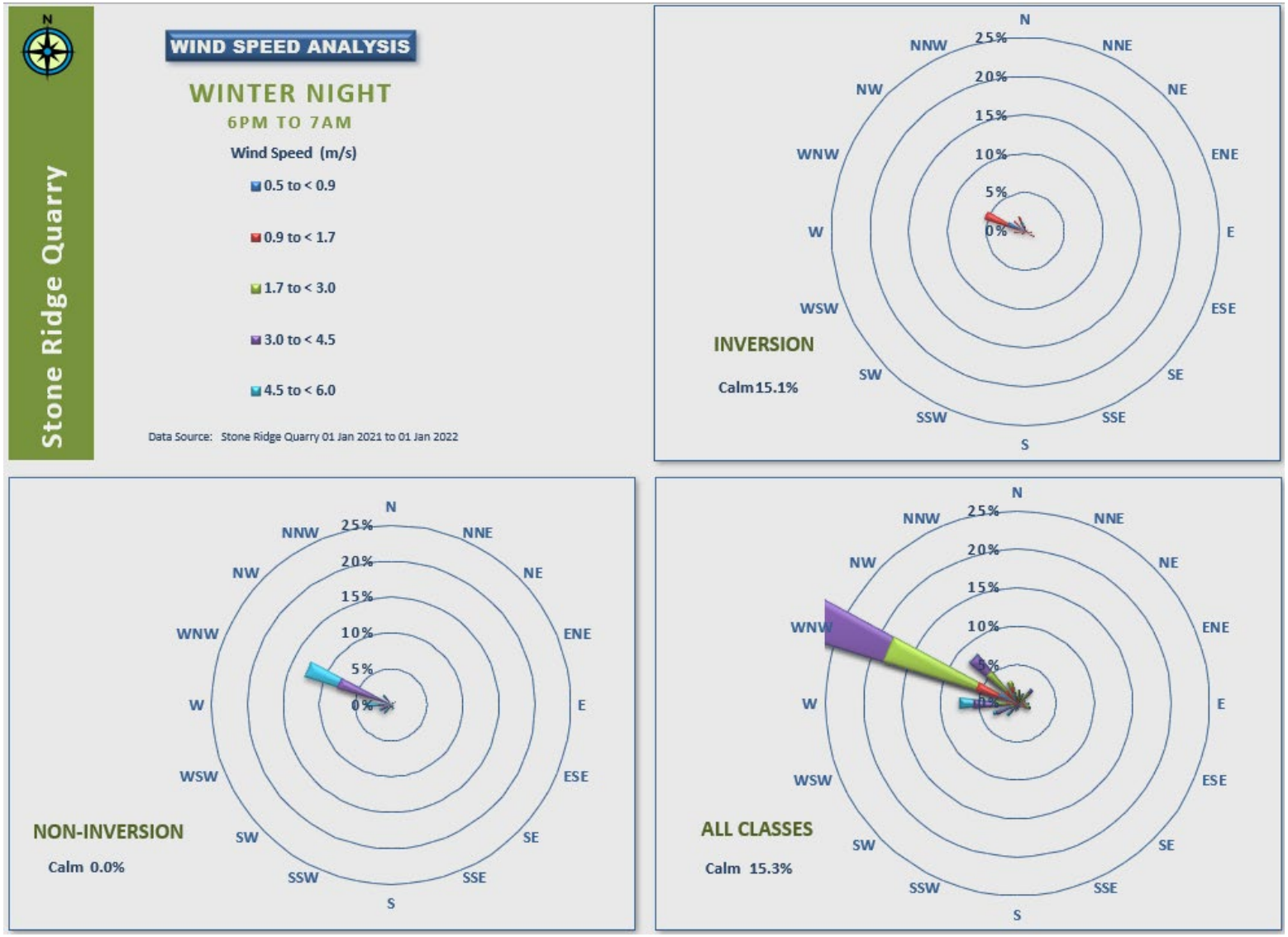


Figure C5 Wind Speed Analysis, Winter Night (6.00 pm to 7.00 am)

NPfI Modelling Parameters

The following conditions are applicable based on the detailed, rather than the default NPfI condition, to assess noise-enhancing meteorological conditions in this noise impact assessment:

- Autumn Nights: WNW winds at 3m/s.
- Winter Nights: Winds at 2m/s plus F-class atmospheric stability weather conditions. The analysis of meteorological data indicates the wind conditions would be calm for 15.1% of the time inversion conditions are present. However, due to the elevation of the quarry to the nearest receivers along Italia Rd and the Pacific HWY, the presence of localised drainage flow would occur. For a conservative assessment, winds a 2m/s have been adopted for all directions.

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