NEVERTIRE SOLAR FARM BESS

Noise Impact Assessment

Prepared for:

RPS Australia Asia Pacific
Level 13/255 Pitt Street
Sydney NSW 2000

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SLR

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with RPS Australia Asia Pacific (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30503-R01-v1.0	19 October 2021	Steven Luzuriaga	Aaron McKenzie	Aaron McKenzie
610.30503-R01-v0.1	27 September 2021	Steven Luzuriaga	Aaron McKenzie	DRAFT

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by RPS Australia Asia Pacific (RPS) to undertake a noise impact assessment for the proposed installation and operation of a Battery Energy Storage System (BESS) at the Nevertire Solar Farm (NSF) located off the Mitchell Hwy in Nevertire NSW. This assessment has been prepared to accompany the Modification Application for the proposal.

This report assesses the potential construction and operational noise and vibration impacts associated with the proposal. Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in **Appendix A**.

1.1 Proposal Description

The Nevertire BESS is located on a 2.5-hectare portion of land across the access road from the NSF. It is approximately 1km northwest of the Nevertire village. It will have a capacity of up to 50 MW of power with energy storage of 100MWh which is 2 hours at capacity at full power rating.

It is expected that the Nevertire BESS will consist of up to 40 shipping container style battery energy storage packs using a lithium technology or similar. The BESS will include battery storage containers, converters, ring main units (RMU), Low Voltage-High Voltage (LV-HV) step-up transformers, High Voltage underground feeders, connection to the NSF 22kV switchboard and associated roads, tracks, fences, and control building.

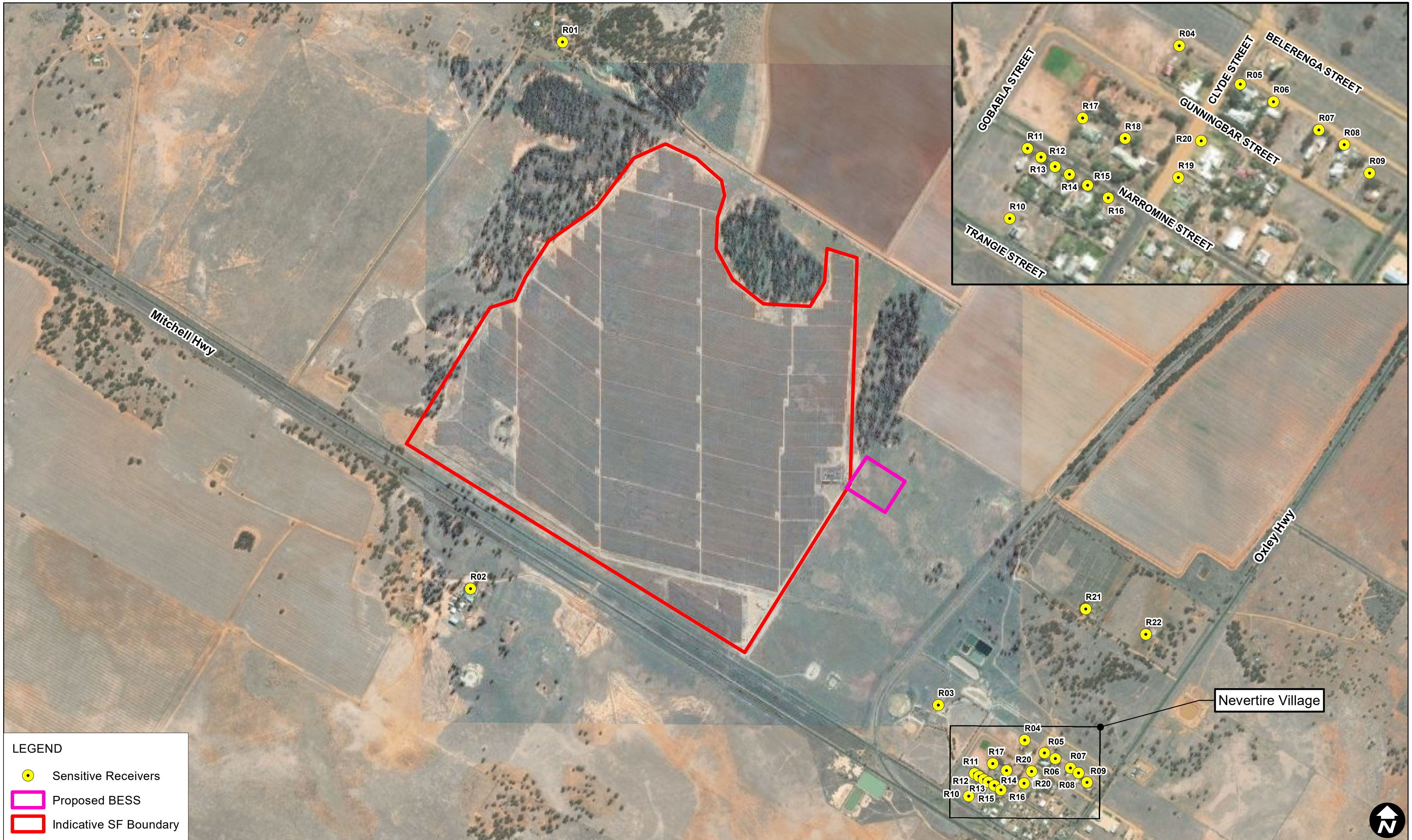
The site location is shown in **Figure 1** and the proposed site layout is shown in **Figure 2**

The BESS will primarily be on automatic control 24 hours per day 7 days per week with very little human intervention. The BESS will typically be controlled by the BESS control system. This control system will automatically determine the state of charge or dis-charge as required.

The identified sources of noise from the operation of the proposed development include:

- Battery Storage Containers
- LV-HV Transformers / RMU Kiosks (6 MVA)
- Control Room Heating, Ventilation, and Air Conditioning (HVAC)

The final layout and design of the NSF BESS is subject to the selection process of technology and original equipment manufacturers (OEM) specifications.



0 0.5 1 km

Scale: 1:19,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 27-Sep-2021
Project Number: 610.30503

SLR

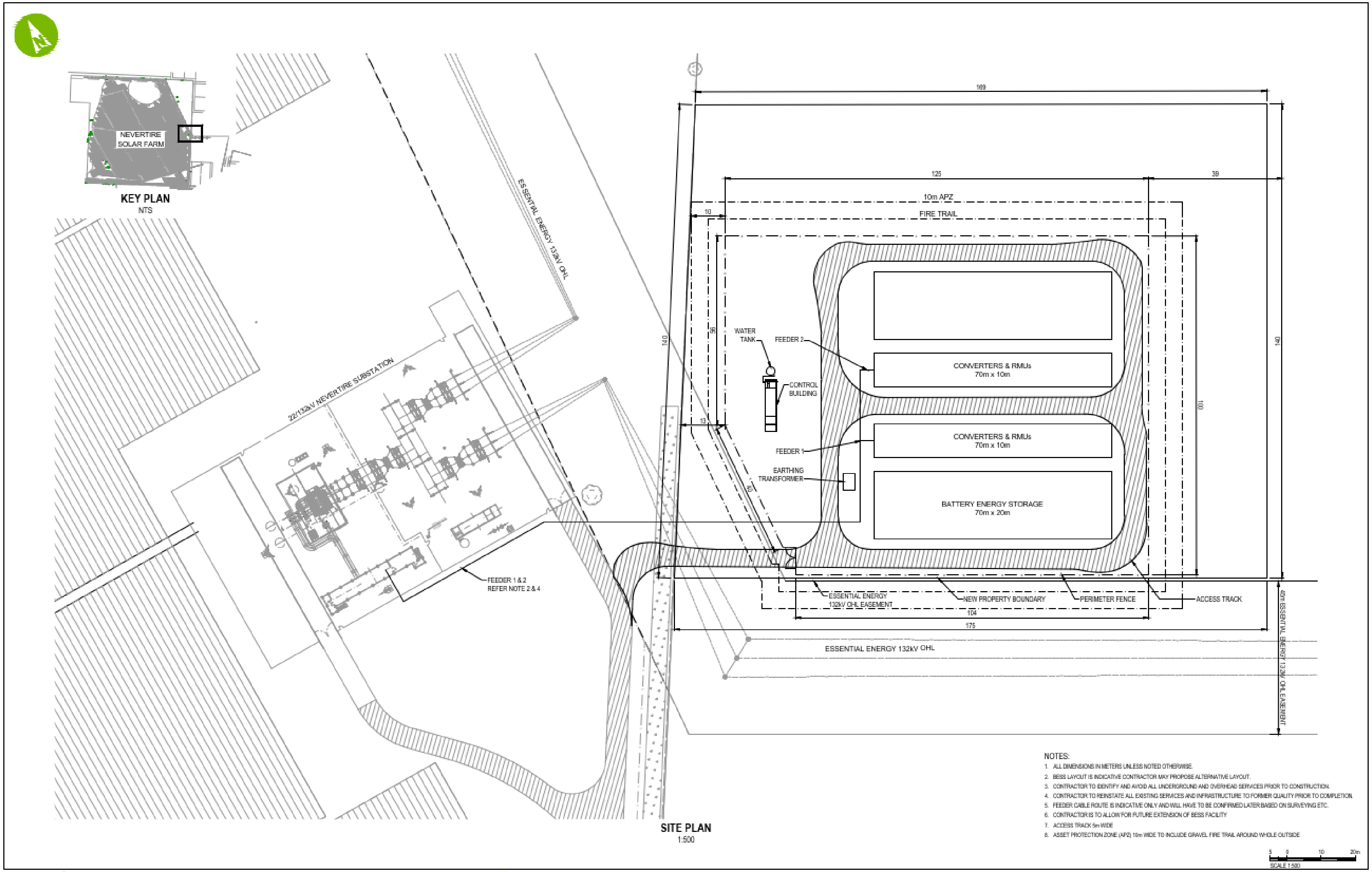
Data Source:
ESRI Basemaps

Site Location

FIGURE 1

\\au.slr.local\corporate\Projects-SLR\610-SrvSYD\610-SYD\610.30503.00000 Nevertire Elliott Green Power BESS\06 SLR Data\01 CADGIS\GIS\SLR6103053_Site_Location_01.mxd

Figure 2 Proposed Development



Source: Aurecon Site Plan (October 2021)

1.2 Nearest Receivers

The nearest sensitive receivers are residential properties located in the village of Nevertire to the southeast of the development with some other rural residential properties scattered around the area. The Nevertire Community Park is also located in the village and has been identified as a passive recreation receiver. The nearest receivers are presented in **Figure 1** and detailed in **Table 1**.

Table 1 Surrounding Sensitive Receivers

ID	Address	Receiver Type	Distance (m)	Direction
R01	9650 Oxley Hwy, Snakes Plain NSW	Residential	2,100	Northwest
R02	10811 Mitchell Hwy, Nevertire NSW	Residential	1,630	Southwest
R03	Nevertire Community Park, Gobabla St, Nevertire NSW	Passive Recreation	890	Southeast
R04	5 Clyde St, Nevertire NSW	Residential	1,140	Southeast
R05	2 Clyde St, Nevertire NSW	Residential	1,220	Southeast
R06	6 Gunningbar St, Nevertire NSW	Residential	1,260	Southeast
R07	12 Gunningbar St, Nevertire NSW	Residential	1,320	Southeast
R08	14 Gunningbar St, Nevertire NSW	Residential	1,360	Southeast
R09	5 Warren St, Nevertire NSW	Residential	1,400	Southeast
R10	2-12 Trangie St, Nevertire NSW	Residential	1,260	Southeast
R11	3 Narromine St, Nevertire NSW	Residential	1,180	Southeast
R12	5 Narromine St, Nevertire NSW	Residential	1,190	Southeast
R13	7 Narromine St, Nevertire NSW	Residential	1,210	Southeast
R14	9 Narromine St, Nevertire NSW	Residential	1,230	Southeast
R15	11 Narromine St, Nevertire NSW	Residential	1,250	Southeast
R16	15 Clyde St, Nevertire NSW	Residential	1,270	Southeast
R17	Narromine St, Nevertire NSW	Residential	1,170	Southeast
R18	9-13 Clyde St, Nevertire NSW	Residential	1,210	Southeast
R19	2 Narromine St, Nevertire NSW	Residential	1,280	Southeast
R20	6 Clyde St, Nevertire NSW	Residential	1,260	Southeast
R21	9650 Oxley Hwy, Nevertire NSW	Residential	930	Southeast
R22	9650A Oxley Hwy, Nevertire NSW	Residential	1,180	Southeast

2 Existing Noise Environment

2.1 Background and Ambient Noise Levels

A baseline noise monitoring campaign was undertaken by Renzo Tonin & Associates (Renzo Tonin) as part of the Nevertire Solar Farm Construction and Operational Noise and Vibration Assessment (NVA). This involved unattended noise monitoring at 9650 Oxley Highway, Snakes Plain between 10 and 18 November 2016. Monitoring was undertaken to measure the existing background and ambient noise environment surrounding the Nevertire Solar Farm.

The results of the NVA baseline noise monitoring campaign have been adopted for this assessment. A summary of the background and ambient noise monitoring results are provided in **Table 2.** Noise monitoring was undertaken at Receiver 01 (R01) presented in **Figure 1**.

Further information regarding the baseline noise assessment, including methodology and detailed data is provided in the NVA (Renzo Ronin 2017).

Table 2 Summary of Ambient and Background Noise Levels

Location ID	Address	Measured Noise Level (dBA)[1]					
		Rating Background Levels (L_{A90})			Ambient Noise Levels (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
R01	9650 Oxley Highway, Snakes Plain	35 (34)[3]	32	30 (27)[3]	67	43	39

Note 1: The Rating Background Levels (RBLs) and Ambient (LAeq) noise levels have been obtained from Renzo Tonin NVA, 2017

Note 2: NSW EPA *Noise Policy for Industry* (NPfI) time periods – Day: 7:00 am to 6:00 pm Monday to Saturday, 8:00 am to 6:00 pm Sundays and public holidays; Evening: 6:00 pm to 10:00 pm; Night: the remaining periods.

Note 3: The NPfI minimum RBL value has been used due to the measured RBL being below the NPfI minimum value.

3 Assessment Criteria

3.1 Interim Construction Noise Guideline

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise at residences and 'other sensitive' land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) based on the existing background noise in the area. Representative 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

3.1.1 Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 3**.

Table 3 Determination of NMLs for Residential Receivers

Time of Day	NML (dBA) $L_{Aeq(15minute)}$	How to Apply
Standard Construction Hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL[1] + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

	Highly Noise Affected
	75 dBA
		The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise.
		• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:
		  ◦ Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences
		  ◦ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Outside Standard Construction Hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW *Industrial Noise Policy* (INP). The INP has been superseded by the NSW EPA *Noise Policy for Industry* (NPfI).

Sleep Disturbance

The ICNG recommends that an assessment of sleep disturbance impacts should be completed where construction works are planned to extend over more than two consecutive nights. The ICNG refers to the NSW *Environmental Criteria for Road Traffic Noise* for assessing the potential impacts, which notes that to limit the level of sleep disturbance the L_1 level (or L_{Amax}) should not exceed the existing L_{90} (or RBL) by more than 15 dB.

3.1.2 Other Sensitive Land Uses

The ICNG NMLs for 'other sensitive' non-residential land uses are shown in **Table 4**.

Table 4 NMLs for 'Other Sensitive' Receivers

Land Use	Noise Management Level $L_{Aeq(15minute)}$ (dBA) (Applied when the property is in use)	
	Internal	External
ICNG 'Other Sensitive' Receivers		
Classrooms at schools and other educational institutions	45	55[1]
Hospital wards and operating theatres	45	65[2]
Places of worship	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

3.1.3 Summary of NMLs

The NMLs for the proposal are determined using the RBLs and are shown in **Table 5**. The works are proposed to occur during Standard Construction Hours so only the daytime NMLs have been adopted for this assessment.

Table 5 Construction Noise Management Levels

Receiver Type	Representative Background Monitoring Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Criteria (RBL +15 dB)
		Standard Construction (RBL +10 dB)	Out of Hours (RBL +5 dB)			
		Daytime	Daytime[1]	Evening	Night-time	
Residential	R01	45	40	37	35	45
Passive Recreation	-	60	60 (when in use)			-

Note 1: This refers to the period on Saturday between 7am – 8am and 1pm – 6pm, on Sunday and public holidays between 8am – 6pm.

3.2 Construction Vibration

Minimum working distances for typical vibration intensive construction equipment are provided in the Roads and Maritime *Construction Noise and Vibration Guideline* (CNVG) and are shown in **Table 6**.

The minimum working distances are for both cosmetic damage (from *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2*, BSI, 1993) and human comfort (from the NSW DEC *Assessing Vibration: A Technical Guideline*, 2006 (AVTG)). Works that occur further from receivers than the minimum distances are unlikely to result in vibration impacts.

Table 6 CNVG Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance	
		Cosmetic Damage (BS 7385)	Human Response (AVTG)
Vibratory Roller	1-2 tonne	5 m	15 m to 20 m
	2-4 tonne	6 m	20 m
	4-6 tonne	12 m	40 m
	7-13 tonne	15 m	100 m
	13-18 tonne	20 m	100 m
	>18 tonne	25 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	73 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

Note 1: More stringent conditions may apply to heritage or other sensitive structures.

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to human response and/or cosmetic damage of typical buildings under typical geotechnical conditions.

3.3 Noise Policy for Industry

The NSW *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW.

3.3.1 Industrial Noise Trigger Levels

The NPfI defines how to determine 'trigger levels' for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

For this assessment, the area surrounding the proposal is considered to be 'Rural' as per the NPfI definitions.

3.3.2 Project Noise Trigger Levels

The trigger levels for industrial noise from the proposal are summarised in **Table 7**. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted below.

Table 7 Project Noise Trigger Levels

Receiver Type	Period	Amenity Noise Level $L_{Aeq(period)}$ (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
			RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
Residential	Daytime	50	35	67	40	48
	Evening	45	32	43	37	43
	Night-time	40	30	39	35	38
Passive Recreation	When in use	50	-	-	-	48

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB, where appropriate, to give the project amenity noise levels due to other sources of industrial noise being present in the area.

Note 3: The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfI.

3.3.3 Modifying Factors

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factors, shown in **Table 8**, which are to be applied where annoying characteristics are present.

Table 8 NPfI Modifying Factors

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfI are exceeded.	2 or 5 dB[2]
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible.	5 dB[3]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB[2] (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.

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

Note 3: Adjustment to be applied to night-time only.

3.3.4 Sleep Disturbance

The NPfI defines the sleep disturbance screening level as:

- 40 dB $L_{Aeq, 15 min}$ or the prevailing RBL plus 5 dB, whichever is greater, and/or
- 52 dB L_{AFmax} or the prevailing RBL plus 15 dB, whichever is greater.

Where the predicted L_{AFmax} noise is above the sleep disturbance screening level then a detailed maximum noise level event assessment should be undertaken, including consideration of the existing maximum noise levels and guidance from current literature regarding sleep disturbance, such as the *Road Noise Policy*.

Due to the type of noise emission sources associated with the proposal (i.e. constant noise emission), the 40 dB $L_{Aeq, 15 min}$ screening level has been adopted for this assessment.

3.4 Road Traffic Noise

The potential for impacts from project related traffic (construction and operation) on the surrounding public road network is assessed using the NSW EPA *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB. Where this is considered likely, further assessment is required using the RNP criteria shown in **Table 9**.

Table 9 RNP Criteria for Assessing Project Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	**Night-time (10 pm – 7 am)**
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4 Construction Assessment

The potential construction noise levels from the BESS have been predicted using ISO 9613:2 algorithm in iNoise V2021. The model includes ground topography, buildings and representative noise sources from the proposal. iNoise (V2021) modelling software achieves the requirements of ISO 17534, 2015 as applicable to the ISO9613:2 calculative algorithm.

The potential impacts have been determined by comparing the predicted noise levels to the NMLs in a 15-minute assessment period.

4.1 Construction Scenarios

The Nevertire BESS is expected to have a design and construction duration of 12 months. This would include a three month design period and a nine month construction, testing and commissioning.

The activities likely required to build the proposal involve conventional construction equipment such as ground excavation equipment, mobile cranes, delivery trucks and trade equipment. The representative construction scenarios developed to assess potential impacts during construction are detailed in **Table 10.**

Table 10 Construction Activities

Works ID	Scenario	Working Hours			
		Standard Daytime	Day OOH[1]	Evening	Night-time
W.001	Site Preparation and Establishment	X	-	-	-
W.002	Earth Works (trenching and digging etc.)	X	-	-	-
W.003	Civil Structures Works (concrete foundations etc.)	X	-	-	-
W.004	Installation of Infrastructure	X	-	-	-
W.005	Demobilisation	X	-	-	-

Note 1: OOH = Out of hours. During the daytime this refers to the period on Saturday between 7am – 8am and 1pm – 6pm, on Sunday and public holidays between 8am – 6pm.

4.1.1 Working Hours

The works would be undertaken during Standard Construction Hours, as outlined in the ICNG. These are:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm on Saturdays
- No work on Public Holidays or Sundays.

It is not expected that there would be any requirement for works during evening or night-time periods.

4.1.2 Construction Activity Source Noise Levels

The assessment uses 'realistic worst-case' scenarios to determine the impacts from the noisiest 15-minute period that is likely to occur for each work scenario, as required by the ICNG. Sound power levels for the construction equipment used in the modelling are listed in **Table 11**.

Table 11 Construction Works and Sound Power Levels for Construction Equipment

ID	Scenario	Sound Power Level (LAeq dBA)															
		Compactor	Concrete Mixer Truck	Concrete Pump	Concrete Saw[1]	Dumper (5 tonne)	Elevated Working Platform	Excavator (22 tonne)	Forklift	Front End Loader	Generator	Grader	Grinder 4"[1]	Hand Tools	Mobile Crane (100 tonne)	Truck	Ute
		108	103	106	119	95	97	99	101	104	102	108	98	94	100	107	98
W.1	Site Preparation and Establishment	X				X		X			X	X				X	X
W.2	Earth Works	X				X		X		X	X					X	X
W.3	Civil Structures Works		X	X							X			X		X	X
W.4	Installation of Infrastructure				X		X		X		X		X		X	X	X
W.5	Demobilisation								X		X				X	X	X

Note 1: The ICNG requires that activities identified as particularly annoying (such as jackhammering, rock breaking and power saw operation) have a 5 dB 'penalty' added to predicted noise levels when using the quantitative method.

Note 2: Sound Power Levels have been adopted from AS2436, DEFRA, RMS *Construction Noise and Vibration Guideline* and TfNSW *Construction Noise and Vibration Strategy*.

4.2 Predicted Construction Noise Levels

Noise predictions from the construction works have been predicted to the nearest receivers during the daytime and are summarised in **Table 12**.

The results represent the worst-case noise levels where all equipment in each scenario is working concurrently. For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted.

Table 12 Predicted Daytime Construction Noise Levels

ID	Receiver Type	Daytime NML	Predicted Noise Level (LAeq, 15min)					Compliant
			W.001	W.002	W.003	W.004	W.005	
R01	Residential	45	36	34	27	33	26	Y
R02	Residential	45	39	37	31	37	29	Y
R03	Passive Recreation	60	48	46	39	46	37	Y
R04	Residential	45	41	39	32	39	30	Y
R05	Residential	45	39	38	31	37	29	Y
R06	Residential	45	43	41	34	41	33	Y
R07	Residential	45	40	39	32	38	30	Y
R08	Residential	45	41	39	32	39	31	Y
R09	Residential	45	41	39	32	39	31	Y
R10	Residential	45	42	40	33	39	31	Y
R11	Residential	45	44	42	35	42	34	Y
R12	Residential	45	44	42	35	41	34	Y
R13	Residential	45	43	41	35	41	33	Y
R14	Residential	45	43	41	34	41	33	Y
R15	Residential	45	43	41	34	41	33	Y
R16	Residential	45	40	39	32	38	30	Y
R17	Residential	45	44	42	35	42	34	Y
R18	Residential	45	43	41	34	41	33	Y
R19	Residential	45	43	41	34	40	32	Y
R20	Residential	45	42	40	34	40	32	Y
R21	Residential	45	**46**	44	38	44	36	**N**
R22	Residential	45	43	41	34	41	33	Y

The predicted noise levels above show the following:

- The highest noise levels (i.e. 48 dBA and 46 dBA) are predicted at R03 and R21 during the W.001 (Site Preparation and Establishment). R21 is the closest residential receiver (approximately 930m) from the proposed development. R03 is the Nevertire Community Park.
- Predicted noise levels are above the daytime NML by 1 dBA at R21 for W.001. These results are inclusive of a 5 dBA penalty to account for ‘particularly annoying activities’.
- Due to the relatively large distance offset between noise sources and receivers, predicted noise levels at all other receivers are below the daytime NML.
- It is noted that works would only occur during Standard Daytime Construction Hours, therefore comparison to other NMLs does not form part of this assessment.

Recommended construction noise mitigation and management measures are discussed in **Section 4.5**.

4.3 Construction Vibration

Based on the equipment and activities identified for the proposed construction, potential sources of vibration are limited and would only occur during W.001 (site preparation and establishment) and W.002 (earth works). Given the large distance offset (> 100 m) to the closest sensitive receivers, vibration is unlikely to be perceptible and impacts are unlikely to occur.

It is therefore anticipated that vibration generated by the construction works will comply with the requirements of the AVTG (human comfort) and BS 7385 (cosmetic and structural damage). No further recommendations for vibration mitigation and management measures are provided in this assessment.

4.4 Construction Traffic

The proposed construction is expected to generate an average of 20 vehicles per day. That would be approximately 40 vehicle movements (in and out) per day. This is expected to increase to approximately 40 vehicles (i.e. 80 movements, 50 light and 30 heavy) during peak construction.

Construction traffic would generally access the site from the Mitchell Highway. Existing daily traffic volumes on the Mitchell Highway in the vicinity of the proposal are in the order of 600 eastbound and 600 westbound vehicles per day. Therefore, the proposal is not anticipated to increase road traffic noise during construction by more than 2 dBA. Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice and an increase of 2 dBA is hardly perceivable, if at all.

The requirements for construction traffic movements would be minimal and would not be expected to result in any additional noise impacts at the nearest receivers due to the existing volumes of traffic on the access roads, noting that a vehicle increase of approximately 60% would be required to increase the noise levels by 2 dBA. As such, no recommendations for road traffic noise mitigation and management measures are warranted or provided in this assessment.

4.5 Construction Recommendations

Noise impacts may be apparent at the nearest receivers at certain times during construction of the proposal. The project should apply all feasible and reasonable mitigation measures to minimise the impacts, particularly during noise intensive works, such as site preparation and earth works.

The following best-practice measures shown in **Table 13** should be implemented to minimise the potential impacts from the works.

Table 13 Standard Construction Recommended Mitigation and Management Measures

Project stage	Measure
Scheduling	Highly noisy intensive works should only be undertaken during the following Standard Construction Hours, unless otherwise assessed and justified: - 7 am to 6 pm Mondays to Fridays, inclusive; and - 8 am to 1 pm Saturdays; and - at no time on Sundays or public holidays.
	Provide appropriate respite periods as per the CNVG when noise intensive works are undertaken or during periods of high noise impacts.
	Carry out community consultation to determine the need and frequency of respite periods, if necessary.
	Avoid loading and unloading of materials / deliveries outside of daytime hours.
Site Layout	Site entry and exit points should be located as far as possible from sensitive receivers.
	Compounds and work areas should be one-way to minimise the need for vehicles to reverse.
	Work compounds, parking areas, equipment and stockpiles should be positioned away from noise-sensitive locations and/or in shielded locations.
	Trucks should not idle near to residential receivers.
	Stationary sources of noise, such as generators, should be located away from sensitive receivers.
Contractor management	Training should be provided to project personnel, including relevant sub-contractors, on noise and vibration requirements and the location of sensitive receivers during inductions and toolbox talks.
	Delivery vehicles should be fitted with straps rather than chains for unloading, wherever possible.
	Truck drivers should avoid compression braking as far as practicable.
	Where night-time works are required, trucks should use broadband reversing alarms.
Noise source mitigation	Use the minimum sized equipment necessary to complete the work and where possible, use alternative, low-impact construction techniques.
	Power tools should use mains power where possible rather than generators.
	Shut down machinery, including generators, when not in operation.
	Avoid dropping materials from a height and dampen or line metal trays, as necessary.
	Ensure equipment is operated in the correct manner.
	All equipment should be appropriately maintained and fitted with noise control devices, where practicable, including acoustic lining of engine bays and air intake / discharge silencers, etc.
Community consultation	Provide appropriate notice to the affected sensitive receivers prior to starting works and before any noisy periods of works.
	Provide signage with a 24 hour contact number.
	Where there are complaints regarding noise, review and implement additional control measures, where feasible and reasonable.
Monitoring	Conduct noise and/or vibration monitoring in response to any formal complaints received.
	Conduct vibration monitoring whenever vibration intensive works are undertaken within the minimum working distances of sensitive receivers or structures.

5 Operational Assessment

The potential operational noise levels from the BESS have been predicted using ISO 9613:2 algorithm in iNoise V2021. The model includes ground topography, buildings and representative noise sources from the proposal. Meteorological corrections have been applied within the modelling software on top of the ISO calculation via the CONCAWE method. iNoise (V2021) modelling software achieves the requirements of ISO 17534, 2015 as applicable to the ISO9613:2 calculative algorithm.

The potential impacts have been determined by comparing the predicted noise levels to the PNTLs in a 15-minute assessment period.

5.1 Operational Scenarios

A summary of the noise sources associated with the operational of the development is provided in **Table 14**.

Modelling has been undertaken without manufacturer specifications; therefore, all sound power levels and associated data are assumed based on information provided at the time of the assessment. It is also assumed that there will be a tonal noise characteristic associated with the BESS equipment, therefore a 5 dBA modifying factor (penalty) has been applied to the predicted noise levels.

Table 14 Operational Noise Sources

Noise Source	Quantity	Emission Height	Sound Power Level (Lw) in dBA per unit
Battery Storage Containers	40	2.6	80
LV-HV Transformers/RMU Kiosks (6 MVA)	10	2	80
Control Room HVAC	1	3	80

Note 1: It is noted that the operation of this equipment is typically tonal and a +5 dB modifying correction factor has been added to the predicted noise level in accordance with the NPfI.

5.2 Weather Conditions

General meteorological conditions for the project-specific noise models included a temperature of 10.9°C (annual mean minimum), and humidity of 64% (annual mean for 9 AM statistics), representative of average conditions for the area. These values were determined based on publically available climate statistics from the Bureau of Meteorology (BOM) Weather Station situated at Trangie Research Station (051049).

Certain weather conditions can increase noise levels by focusing noise towards receivers. Noise-enhancing weather conditions can occur where wind blows from the source to the receiver, or where temperature inversions occur.

The NPfI defines ‘standard’ and ‘noise-enhancing’ weather conditions as shown in **Table 15**. Noise-enhancing weather should be included in the assessment where they occur for more than 30% of the daytime, evening or night-time period in any season.

Table 15 Standard and Noise-Enhancing Weather Conditions

Weather Conditions	Meteorological Parameters
Standard	Daytime/evening/night-time: stability categories A–D with wind speed up to 0.5 m/s
Noise-enhancing	Daytime/evening: stability categories A–D with light winds up to 3 m/s Night-time: stability categories A–D with light winds up to 3 m/s and/or stability category F with winds up to 2 m/s

The NPfI contains guidance for determining prevailing weather conditions. Data measured for 12-months between January and December 2019 at Trangie Research Station (ID:051049) has been used to determine the prevailing weather conditions at the proposal site and a summary is shown in **Table 16**.

Table 16 Assessment Noise Enhancing Weather Conditions

Period	Frequency of Occurrence Greater than 30%				
	Wind				Atmospheric Stability Class F or G[1]
	Calm	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s	
Daytime	-	-	-	-	-
Evening	-	-	-	-	-
Night-time	-	-	-	Yes	Yes

Note 1: Noise-enhancing conditions for temperature inversions based on atmospheric stability class are only applied to the night-time assessment.

The weather analysis shows that noise-enhancing weather conditions are expected to be a feature of the proposal site. The weather analysis revealed that prevailing wind direction for the assessment is from the southeast during the night time periods in Autumn and Winter. To provide a conservative assessment, a source to receiver wind has been adopted for all receivers and it is assumed that a temperature inversion (Stability Class F) condition can also occur during the night time period. Standard and noise enhancing weather conditions have been adopted for the assessment as shown in **Table 15**.

5.3 Predicted Operational Noise Levels

A summary of the predicted operational noise assessment at the receivers surrounding the proposal is shown in **Table 17**. These predicted levels are compared to the PNTLs to determine the potential for noise impacts.

Table 17 Industrial Noise Assessment

Receiver ID	Project Noise Trigger Level $L_{Aeq(15minute)}$ (dBA)			Predicted Noise Level[1] $L_{Aeq(15minute)}$ (dBA)		Compliant?
	Day (D)	Evening (E)	Night (N)	Standard (D/E/N)	Noise Enhancing (E/N)	
R01	40	37	35	17	20	Y
R02	40	37	35	21	24	Y
R03	48 (When in use)			29	31	Y
R04	40	37	35	25	28	Y
R05	40	37	35	24	27	Y
R06	40	37	35	24	27	Y
R07	40	37	35	23	26	Y
R08	40	37	35	23	26	Y
R09	40	37	35	23	26	Y
R10	40	37	35	24	27	Y
R11	40	37	35	25	28	Y
R12	40	37	35	25	28	Y
R13	40	37	35	25	28	Y
R14	40	37	35	25	28	Y
R15	40	37	35	24	27	Y
R16	40	37	35	23	26	Y
R17	40	37	35	25	28	Y
R18	40	37	35	25	28	Y
R19	40	37	35	24	27	Y
R20	40	37	35	24	27	Y
R21	40	37	35	28	31	Y
R22	40	37	35	25	28	Y

Note 1: Predicted levels are inclusive of a 5 dBA modifying factor to account for tonal characteristics for the BESS noise emission sources.

The predicted noise levels above show the following:

- The highest noise levels (i.e. 31 dBA) are predicted at R03 and R21 during noise enhancing weather conditions. R03 and R21 are the closest receivers (approximately 900m) from the proposed development.
- Noise levels are predicted to be approximately 3 dBA higher during noise enhancing conditions.

- The predicted noise from the proposal complies with the Project Noise Trigger Levels at all receivers during all periods and weather conditions.
- Predicted $L_{Aeq,\ 15\ minute}$ noise levels are also compliant with the sleep disturbance screening level of 40 dBA.

Based on the results and findings discussed above, recommended safeguards and provisions for monitoring are provided in **Section 5.6**. They are designed to assist in maintaining compliance and minimise any residual impacts as far is commonly feasible, reasonable, and safe to do so.

5.4 Cumulative Operations

To assess cumulative noise emissions from the Nevertire Solar farm (including substation) and the Nevertire BESS a conservative logarithmic addition of potential worst-case operational noise (noise enhancing conditions) was adopted for the closest receiver where the highest noise levels were predicted. (i.e. R03 - Nevertire Community Park, Gobabla St, Nevertire NSW).

When considering the worst-case predicted noise level from Nevertire Solar Farm (i.e. 30 dBA from the NVA), the Nevertire Substation (i.e. 19 dBA based on a sound power level of 95 dBA) and the predicted operational noise level of the BESS (i.e. 31 dBA), the predicted $L_{eq,\ 15\ minute}$ noise level for concurrent operation of the Nevertire Solar Farm (including substation) and the BESS at R03 is 34 dBA. This is below the criteria of 48 dBA for passive recreation receivers. It is also below the most stringent night time criteria of 35 dBA for residential receivers. It is noted that all residential receivers are located further from the project than R03 and therefore cumulative noise levels are anticipated to be equal to or lower than those predicted at R03.

Operational emissions of the Nevertire Solar Farm with the additional of the BESS is therefore compliant with the NPfI requirements.

5.5 Operational Traffic

Operational road traffic noise impacts from the proposal are not anticipated (i.e. from additional vehicles on the public road network). The BESS facility will be on automatic control, and any periodic maintenance would be undertaken by staff from the Nevertire Solar Farm. Additional traffic from the proposal will therefore be minimal.

For arterial and sub-arterial roads (e.g. Mitchell Highway) the proposal will not generate a significant increase in vehicles when compared to that of the existing vehicle flows and mixes on the surrounding road network. The introduction of the proposal’s operational traffic is unlikely to be perceptible.

5.6 Operational Recommendations

Based on the findings presented above, all predicted operational $L_{Aeq,\ 15\ minute}$ noise levels for worst-case proposed operations are below the PNTL at all identified receivers. The BESS is deemed compliant with the NPfI for the daytime, evening and night-time periods. As such no further recommendations for noise reducing mitigation or management measures are provided in this report. Suitable safeguards and provisions for monitoring have been recommended below, to assist operational noise levels being maintained below the applicable PNTL.

5.6.1 Safeguards and Provisions for Monitoring

Operational compliance has been achieved with the assumption that noise emission sources include:

- 40 x Battery Storage Containers with Lw of 80 dBA per unit which may generate tonal noise.
- 10 x LV-HV Transformers / RMU Kiosks (6MVA) with Lw of 80 dBA per unit.
- 1 x Control Room HVAC with Lw of 80 dBA.

On this basis the following safeguards and provisions are provided:

- During detailed design / equipment procurement, ensure that the BESS noise emission sources achieve quantities and sound power levels equal to or lower than presented in this report. If overall BESS noise emissions are expected to be higher, additional assessment should be considered.
- Where new and improved BESS technology becomes available within the life of the project, replacement of BESS equipment should aim to achieve sound power levels equal to or lower than presented in this report. If overall BESS noise emissions are expected to be higher, additional assessment should be considered.
- All formal / reoccurring operational noise complaints should be investigated and where necessary, operator attended noise compliance measurements should be undertaken to measure and compare the site noise level contributions to the predicted values and the PNTLs presented in this report.
  - All site noise levels should be measured to exclude any influential source not associated with the project.
  - If the measured site noise levels are below the predicted values and comply with the PNTLs presented in this report, no further mitigation or management measures are required.
  - If the measured site noise levels are above the predicted noise levels or PNTLs presented in this report, further mitigation and/or management measures should be considered.

6 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions from the proposed Battery Energy Storage System (BESS) at the Nevertire Solar Farm located off the Mitchell Hwy in Nevertire NSW.

The proposed Nevertire BESS will consist of up to 40 shipping container style battery energy storage packs using a lithium technology or similar. The BESS will include battery storage containers, converters, ring main units (RMU), low voltage-high voltage (LV-HV) step-up transformers, high voltage underground feeders, connection to the Nevertire Solar Farm 22kV switchboard and associated roads, tracks, fences, and control building.

The BESS will primarily be on automatic control 24 hours per day 7 days per week with very little human intervention. The functioning of the BESS will typically be controlled by the BESS control system. This control system will automatically determine the state of charge or dis-charge as required.

The construction noise assessment identified that predicted $L_{Aeq,\ 15\ minute}$ noise levels have the potential to exceed the Noise Management Levels (NMLs) at certain times when the noisiest works are occurring. The worst-case impacts are, however, only likely to occur for relatively short times of the total project duration and the works would be limited to Standard Daytime Construction Hours, with no evening or night-time works required. A number of best-practice mitigation and management measures have been recommended to be applied, where feasible and reasonable, to control and minimise the impacts during construction as far as practicable.

The operational noise assessment identified that all predicted $L_{Aeq,\ 15\ minute}$ noise levels for the proposed operations of the BESS are below the project noise trigger levels (PNTL) at all the identified receivers. Cumulative noise emissions from the Nevertire Solar Farm (including substation) and the Nevertire BESS were also considered. Cumulative $L_{Aeq,\ 15\ minute}$ noise levels during noise enhancing weather conditions (i.e. worst-case) are expected to remain below the most stringent night time criteria of 35 dBA.

Operational emissions of the Nevertire Solar Farm with the additional of the BESS is therefore compliant with the NPfI requirements for all assessment periods. As such no further recommendations for noise reducing mitigation or management measures are provided in this report. Suitable safeguards and provisions for monitoring have been recommended to assist operational noise levels being maintained below the applicable PNTL.

Based on the findings of this report and assuming the recommendations and/or safeguards are applied, the proposal is considered appropriate from an acoustic standpoint.

7 References

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Department for Environment, Food and Rural Affairs (DEFRA), **Noise Database for Prediction of Noise on Construction and Open Sites**, December 2004.

International Organisation for Standardisation (ISO) 9613 Part 2 - 1996 (ISO 9613:2, 1996) - **Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation.**

International Organisation for Standardisation (ISO) 17534 – 2015 – (ISO 17534, 2015) – **Acoustics - Software for the Calculation of Sound Outdoors.**

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

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

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Standards Australia AS 2436–2010 (AS 2436, 2010) – **Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.**

Transport for NSW (TfNSW) - **Construction Noise and Vibration Strategy (CNVS)**, ST-157/4.1, April 2019

APPENDIX A

Acoustic Glossary

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

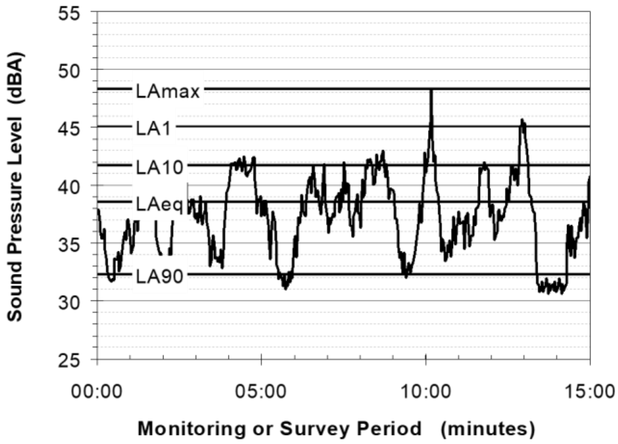
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

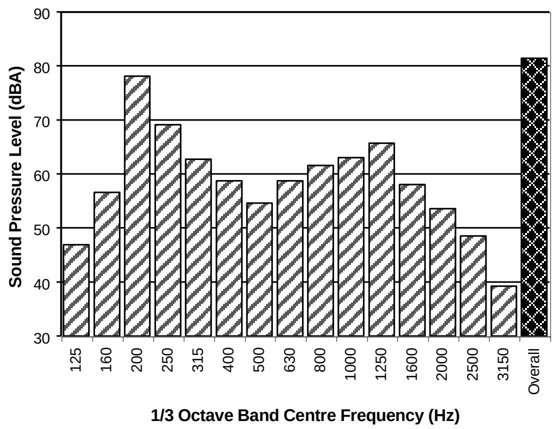
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

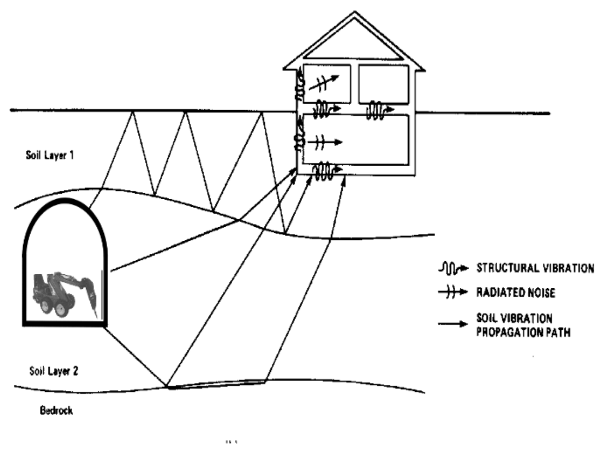
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

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