GARA BESS: NOISE & VIBRATION IMPACT ASSESSMENT

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Assured Environmental

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Table 1: History of Revisions

Revision	Date	Issued to	Changes
R0	23/09/2024	B. Aslan	Initial Release
R1	14/11/2024	B. Aslan	Client Comments
R2	22/11/2024	B. Aslan	Minor Changes
R3	4/12/2024	J. Bai	Update to Cumulative Assessment
R4	5/03/2024	J. Bai	Client Comments, Update to Cumulative Assessment, Update to Road Traffic Assessment
R5	12/03/2024	J. Bai	Minor Changes
R6	16/05/2025	H. Sicaid	Update to modelling scenario.
R7	1/10/2025	J. Bai	Update to Site Layout and Equipment Selection
R8	24/10/2025	H. Sicaid	Minor Changes, Update to Construction Assessment

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

A-Weighting	A response provided by an electronic circuit which modifies sound in such a way that the resulting level is similar to that perceived by the human ear.
dB (decibel)	This is the scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and the reference pressure (0.00002 N/m^2).
dB(A) or dBA	This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Free-field	Refers to a sound pressure level determined at a point away from reflective surfaces other than the ground with no significant contribution due to sound from other reflective surfaces; generally, as measured outside and away from buildings.
L_{Aeq}	This is the equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period. Noise levels often fluctuate over a wide range with time. Therefore, when a noise varies over time, the L_{Aeq} is the equivalent continuous sound which would contain the same sound energy as the time varying sound. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.
L_{A10}, L_{A90}, L_{An}	Noise level exceeded for n% of the measurement period with A-weighted, calculated by statistical analysis - where n is between 0.01% and 99.99%. For example, L_{A10} is the noise level just exceeded for 10% of the measurement period, calculated by statistical analysis and used to determine traffic noise and L_{A90} is the noise level exceeded for 90% of the measurement period, A-weighted and calculated by statistical analysis and used to determine background noise levels.
L_{AFmax}	A-weighted, fast response, maximum, sound level.
L_{AFmin}	A-weighted, fast response, minimum, sound level.
RBL	Rating background noise level – the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
SWL	Sound Power Level in decibels is ten times the logarithm of the ratio of the sound power to the sound power reference level of 1 pico Watt.

ABBREVIATIONS

BESS	Battery Energy Storage System
MVPS	Medium Voltage Power Station
LIDAR	Light Direction and Ranging
EPA	Environmental Protection Authority (NSW)
ICNG	Interim Construction Noise Guidelines
NPfI	Noise Policy for Industry
DEC	Department of Environment and Conservation (NSW)
DECC	Department of Environment and Climate Change (NSW)
DECCW	Department of Environment, Climate Change and Water (NSW)
CRTN	Calculation of Road Traffic Noise
RNP	Road Noise Policy (NSW)
VDV	Vibration Dose Value
RMS	Root Mean Square
PPV	Peak Particle Velocity

1 INTRODUCTION

1.1 Scope of Assessment

Assured Environmental (AE) was appointed by ACEnergy Pty Ltd to undertake a noise and vibration impact assessment for a proposed Battery Energy Storage System (BESS). The BESS site will have a total capacity of approximately 400MW with a total storage capacity of 1,760MWh. The development site is located at 86 Woodlands Road, Armidale, (herein referred to as the "Subject Site").

The noise and vibration study has been undertaken to assess the potential impacts of the construction and operation of the BESS, on nearby sensitive receptors in accordance with the following NSW policies and guidelines

- NSW Noise Policy for Industry (NPfI) (EPA, 2017)
- NSW Assessing Vibration: a technical guideline (DEC, 2006);
- NSW Road Noise Policy (DECCW, 2011); and
- Draft Construction Noise Guideline (EPA, 2017)

In accordance with the requirements of the above guidelines, computational modelling and first principle calculations have been undertaken to support the assessment of the potential for adverse amenity impacts as a result of the development.

1.2 This Report

This report presents the noise and vibration impact assessment in accordance with the agreed scope of work.

2 SITE OVERVIEW

2.1 Subject Site

The proposed Subject Site is located approximately 8 km west of Armidale in northern New South Wales. The proposed Gara BESS development is to be located at 86 Woodlands Road, Armidale NSW 2350 (the Host Lot). 86 Woodlands Road is formed of several larger land parcels including Lot 1 DP246878; Lot 1 DP573787 and Lot 145 DP755826, on which the development will impact on. The remainder of the larger landholding is formed by other non-associated lots with a total area of approximately 423 ha.

The Gara BESS will also impact on neighbouring properties being Lots 144 and 153 DP755826 and Travelling Stock Routes (TSR's) Lot 7003 DP1060212; Lot 7009 DP1060213.

The site will occupy an area of approximately 32.97 ha across part of Lot 1 DP246878 and Lot 1 DP753787 and extend into the Waterfall Way (also referred to as Grafton Road) road reserve and Crown Land managed as Travelling Stock Reserves defined as Lot 7003 DP1060212 and Lot 7009 DP1060213 for site access. The transmission easement would impact Lot 1 DP246878 and Lots 144, 145 and 153 DP755826, together with an unconstructed Crown Road reserve located unilaterally between Lots 144 and 145.

The area surrounding the proposed Subject Site includes land in use for agricultural purposes with associated rural dwellings.

2.2 Project Overview

ACEnergy Pty Ltd (the Applicant) is proposing to develop an approximately 400-Megawatt AC (MWAC), 1,760 MW hour (MWh) Battery Energy Storage System (BESS). The proposed BESS will help balance electrical demand and supply assists management of variation in electrical demand and supply. The proposed development is consequently consistent with the objective of the NSW Government's Climate Change Policy Framework (NSW, 2016), supporting transitions toward lower emissions and improving the resilience of NSW to a changing climate.

The project includes the following key infrastructure.

- 336 Enclosed lithium-ion batteries (BESS Units);
- 112 Power conversion systems including associated transformers (MVPS);
- Underground power and fibre optic cabling interconnecting the equipment;
- Grid connection equipment including switchgear, protection and control equipment, metering, reactive power equipment, filtering equipment, auxiliary transformers, and enclosures/buildings for housing equipment;
- Overhead 330kV sub-transmission lines to connect the BESS to the existing Transgrid transmission line. A summary of the connection works is as follows;
- Cut-in to existing 330kV line through installation of interface structures to replace the existing tower;
- Establishment of a new 330kV switching station within the development site;

- Loop-in, loop-out 330kV overhead lines connecting the line interface to the new switching station with approximately 1 km length and supported by dual-circuit tower structures;
- Earthing and lightning protection systems;
- Site office, storage area/enclosure, internal access tracks, on-site parking, security fencing, CCTV, and temporary construction laydown area;
- 10 m Vegetation screening around the BESS facility and an extra 10 m vegetation on the eastern portion of the dedicated connection asset area; and
- Provision of upgrading existing site access from Waterfall Way to the south.

The primary components associated with the installation of the BESS are as follows:

- Site investigations, vegetation clearing, levelling, access way construction, drainage system installation and installation of foundations/supports to install equipment on.
- Transport to site and installation of equipment;
- Testing and commissioning of the equipment; and
- Operation and maintenance.

2.3 Nearby Sensitive Receptors

There are 21 single existing dwellings located in the vicinity of the proposed BESS. Table 2 and Figure 1 provide a summary of selected sensitive receptors to the proposed Subject Site and approximate distance to the infrastructure.

Table 2: Nearby Sensitive Receptors

Receptor	Description	Coordinates (EPSG 32756)		Distance to infrastructure (m)[a)]	Height (m)
		Easting	Northing		
R01	Existing Dwelling	382395	6621105	648	1.5 [b)]
R02	Existing Dwelling	381109	6620252	746	1.5 [b)]
R03	Existing Dwelling	382477	6620923	719	1.5 [b)]
R04	Existing Dwelling	380903	6621407	724	1.5 [b)]
R05	Existing Dwelling	380740	6620145	1063	1.5 [b)]
R06	Existing Dwelling	380331	6620796	1133	1.5 [b)]
R07	Existing Dwelling	382272	6619280	1585	1.5 [b)]
R08	Existing Dwelling	380553	6622483	1764	1.5 [b)]
R09	Existing Dwelling	383372	6620710	1612	1.5 [b)]
R10	Existing Dwelling	380507	6622789	2050	1.5 [b)]
R11	Existing Dwelling	383528	6620809	1766	1.5 [b)]
R12	Existing Dwelling	379809	6621316	1722	1.5 [b)]
R13	Existing Dwelling	383448	6619211	2304	1.5 [b)]
R14	Existing Dwelling	380038	6622662	2216	1.5 [b)]
R15	Existing Dwelling	379612	6621321	1916	1.5 [b)]

Receptor	Description	Coordinates (EPSG 32756)		Distance to infrastructure (m)[a)]	Height (m)
		Easting	Northing		
R16	Existing Dwelling	379562	6621147	1945	1.5 [b)]
R17	Existing Dwelling	381611	6618498	2286	1.5 [b)]
R18	Existing Dwelling	379653	6620006	2046	1.5 [b)]
R19	Existing Dwelling	379320	6620793	2027	1.5 [b)]
R20	Existing Dwelling	381495	6618540	2253	1.5 [b)]
R21	Approved (yet to be constructed)	379426	6620929	2071	1.5 [b)]

a) Distance measured from receptor to noise producing equipment on-site.
b) Residences modelled as single storey receptors ~1.5 m

See Appendix C for map of receptor locations.

2.4 Topography

Figure 2 illustrates the local topography, as obtained from the NSW Six Maps. It can be seen the Subject Site is approximately 980 m AHD. The topography is relatively flat with slight undulations to the west and east of the site.

Appendix D illustrates the topography specific to the Subject Site, these levels were specified as topography of the Subject Site post development.

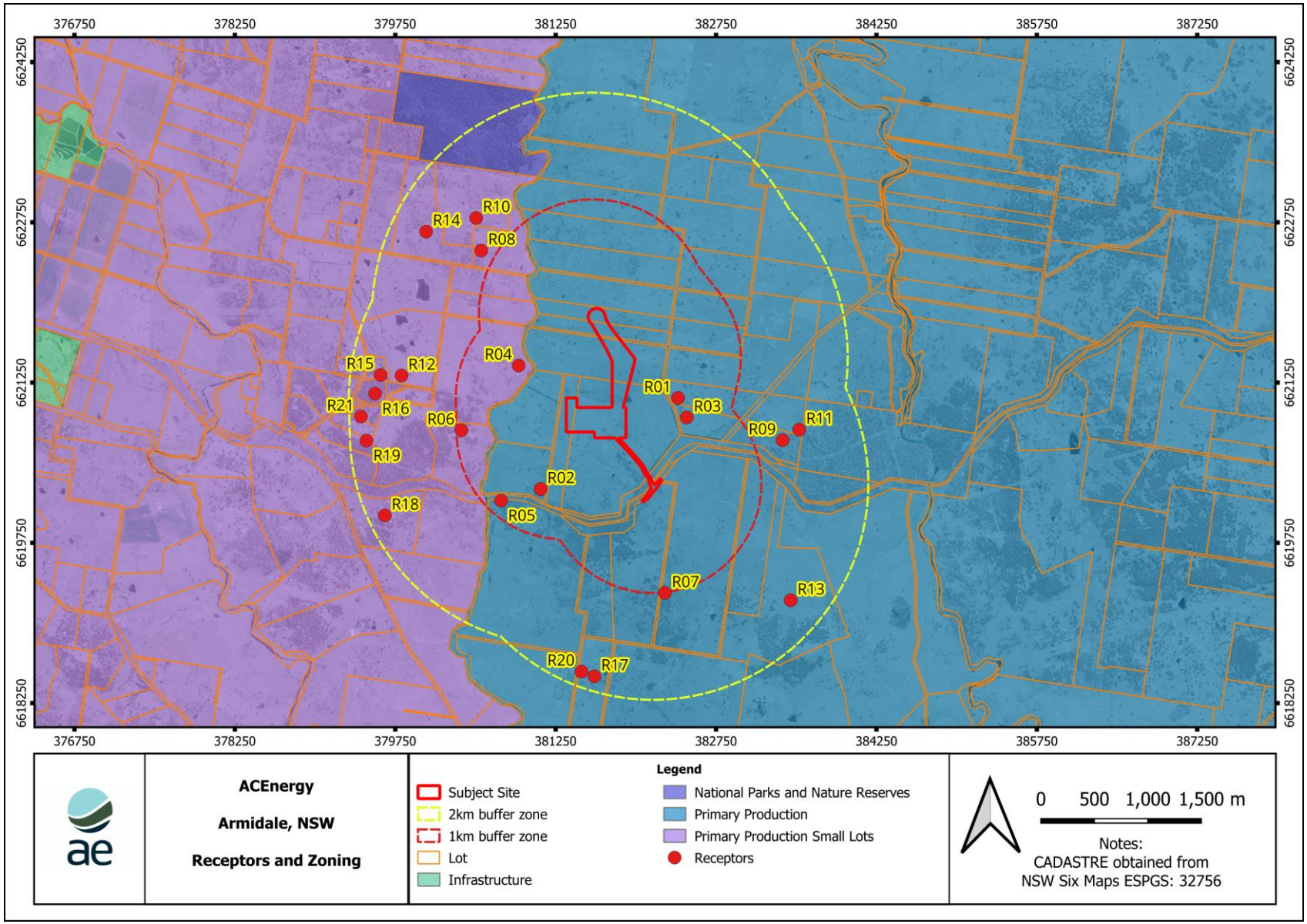

Figure 1: Site Overview

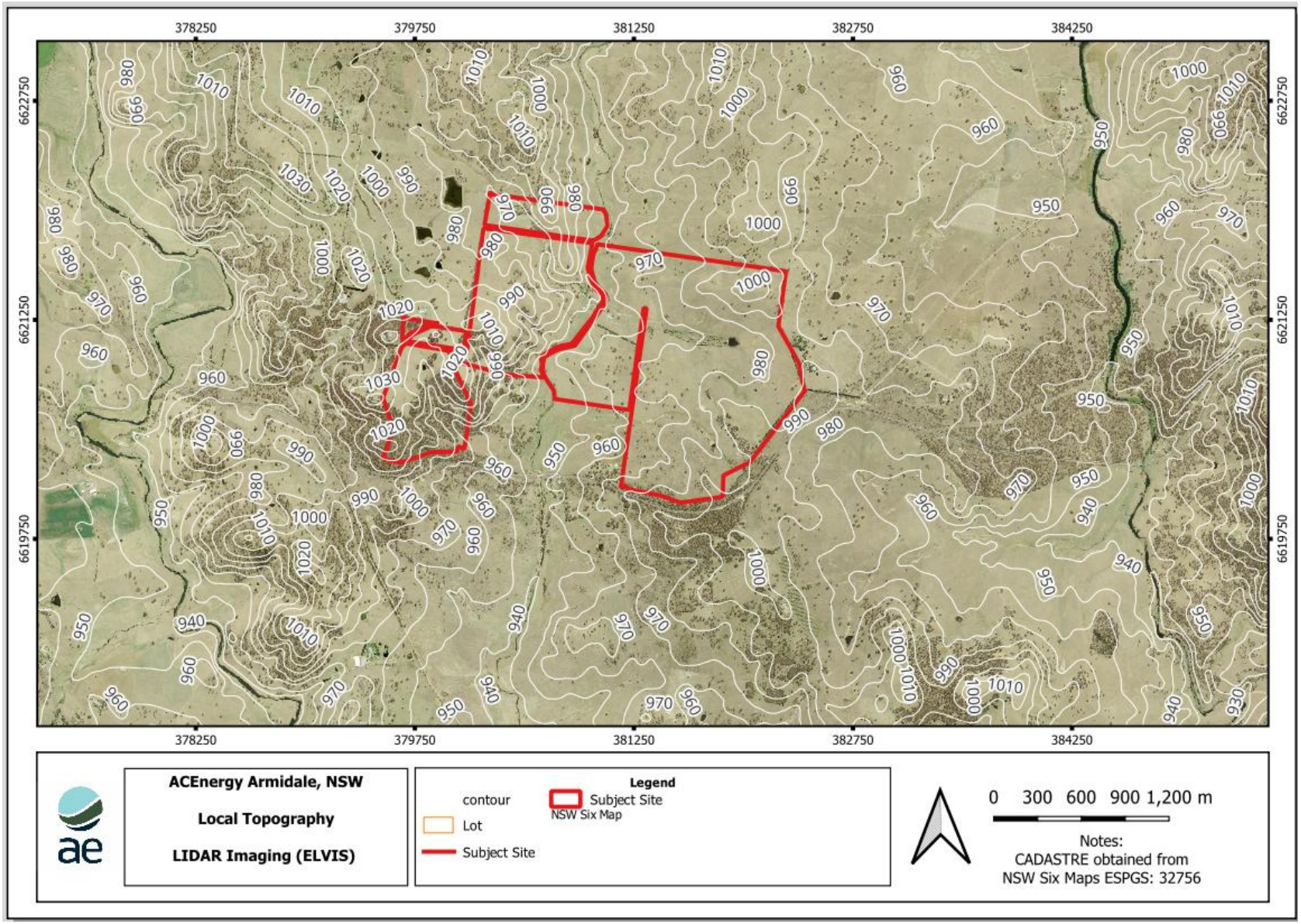

Figure 2: Site Local Topography

3 CONSTRUCTION NOISE ASSESSMENT

3.1 Duration of Construction Works

The construction of the BESS is expected to take approximately 60 weeks (~14 months) with a peak construction period of approximately 4 months. A number of different activities will be undertaken over that time. Construction is expected to commence in early 2027.

Construction would be restricted to what the EPA term 'recommended construction hours' (as described in Table 3) which are between 7 am and 6 pm Monday to Friday and 8 am to 1 pm Saturday, with no works on Sundays or Public Holidays.

The assessment has therefore considered the potential for adverse amenity impacts associated with construction during recommended standard hours only.

Table 3: Standard Construction Hours

Work type	Weekday	Saturday	Sunday or Public Holiday
Normal Construction	0700 to 1800	0800 to 1300	No work

3.2 Interim Construction Noise Guideline

Guidance on the assessment and management of construction noise in NSW is provided in the Interim Construction Noise Guideline (2009) (ICNG) published by the NSW EPA.

The main objectives of the Guideline are to:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours, unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage;
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts; and
- Provide guidelines for assessing noise generated during the construction phase of developments.

In achieving these objectives, the guideline provides a framework for the qualitative and quantitative assessment of potential construction noise impacts noting that, for major projects, a quantitative assessment is the preferred approach.

Table 4 presents construction noise criteria outlined in the guideline. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for

measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

Table 4: NSW EPA Construction Noise Criteria – Residential Receivers

Time of Day	Management Level (Free-field)	How to Apply
Recommended standard 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 + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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 recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Where nearby sensitive uses are predicted to be noise affected, the proponent of the project is required to apply reasonable and feasible noise mitigation measures noting that a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic, and environmental effects.

For construction outside standard hours, the assessment criteria has been determined based on the minimum allowable RBL as provided in the NPfI. That is, for the purposes of the assessment it is assumed that the RBL is 40 dB(A) for daytime periods (standard operating hours) thereby resulting in a noise affected management level of 50 dB(A) and a highly noise affected management level of 75 dB(A).

3.3 Construction Noise Sources

Table 5 presents a summary of the plant and equipment likely to be required to complete the on-site construction works. The sound power levels presented have been sourced from published noise emission datasets and the library of source noise levels maintained by Assured Environmental.

Table 5: Construction Noise Sources

Construction Phase	Plant Item	Number Required	Sound Power Level, dB(A)	Acoustical Usage Factor, % [a)]
Site establishment, construction of fencing, drainage & roads.	Truck & Dog	2	113	40
	Compactor	2	106	20
	Bulldozer	1	109	40
	Water Cart	1	103	40
	Backhoe	1	110	20
	Excavator	1	102	20
	Road Truck	4	114	20
	Vibratory Roller	2	112	20
Concrete footing installation	Concrete truck	2-5 per day	99-106	40
	Excavator	2	102	40
	Concrete truck discharge	2	96	100
Delivery and installation of Cabling	Fanna Crane	2	101	16
	Excavator	1	110	20
	Hand Tools	3	100	40
Steel platform installation	Fanne Crane	2	98	40
	Truck and Dog	2	110	16
	Hand Tools	4	101	40
BESS and inverter container installation including electrical	Piling Rig	1	112	20
	Fanna Crane	2	98	16
	Loader	2	110	40
	Trucks	3	113	20
	Hand Tools	1	95	40
	Generator	1	102	50
Control room building and Demobilisation	Excavator	1	110	50
	Fanna Crane	2	98	16
	Front end Loader	1	112	40
	Truck and Dog	1	110	50
	Generator	2	102	40
Decommissioning of BESS infrastructure	Fanna Crane	2	98	16
	Excavator	2	110	50
	Excavator+ Hydraulic hammer	1	122	100
	Truck and Dog	4	110	40
	Trucks	4	113	20
	Front end Loader	1	112	40
	Bulldozer	1	116	40
	Generator	1	102	40

Construction Phase	Plant Item	Number Required	Sound Power Level, dB(A)	Acoustical Usage Factor, % [a)]
Peak construction period [(b)]	Light Vehicle	43 / day		
	Heavy Vehicle	75 / day		

a) Acoustic Usage Factor represents the percentage of time that a particular item of equipment is assumed to be running at full power while working on site.

b) Noise contribution from vehicles during construction period is assessed under road traffic assessment.

Construction activities across the site will vary in location and duration; mobile plant will move around the Subject Site throughout the construction phase, whereas activities such as trenching, and piling will slowly move along the line of BESS equipment. The project proposes concrete pier footings for MVPS and BESS containers which does not require piling. However, direct driving footing, which requires piling, could be made possible depending on the soil conditions as a result of geotechnical investigation. Therefore, piling activities are included in this assessment as a conservative approach to modelling potential construction noise.

As such, whilst the piling activities are noisy, once each pile is complete, the area is not revisited and therefore the highest predicted noise levels associated with piling will be short-lived for each receptor.

Table 6 presents predicted most affected receptor noise levels taking into consideration the following assumptions:

- All equipment and plant are in the same area – at the closest point to the Project Area boundary to the receptors. This is considered to be a hypothetical worst-case scenario and unlikely to occur.
- The equipment quantities are currently estimates.
- Propagation is assumed to occur over hard ground and no screening objects between the source and the receiver; and
- Construction phases assessed independently at each sensitive receptor.

It is noted that noise level estimates were calculated using worst case scenario with no ground absorption and minimum distances between plant equipment and sensitive receptors. In practice, construction activities will take place at variable distances, as such the construction assessment is conservative and actual construction noise levels would be lower than those predicted.

3.4 Assessment of Construction Noise Impacts

For the purposes of predicting impacts associated with noise emissions from the development Footprint on nearby sensitive receptors, calculations of the noise impacts from construction activities have been undertaken using first principal calculations based on the distance separation of the receptor and the facility infrastructure.

Table 6 presents the predicted construction noise levels when each phase of construction is considered individually (i.e. construction stages do not overlap).

To evaluate a realistic worst-case construction noise scenario, overlapping construction stages have been considered in modelling for this construction noise assessment. The results presented in Table 7 demonstrate the predicted noise levels at sensitive receptors when construction stages are occurring concurrently.

The results presented in Table 7 assume that no more than two construction phases will be occurring at any given time. It is noted that the decommissioning phase was not considered in this concurrent assessment as it will occur at the end of the Subject Site life cycle and will not occur concurrently with any other construction phase.

When construction phases are considered concurrently there are multiple sensitive receptors expected to be above the noise affected management levels but do not exceed the highly affected noise criteria.

It is further noted that when all construction phases are considered concurrently (not inclusive of decommissioning phase) at the closest sensitive receptor R1 (most affected receptor) it is predicted the noise levels do not exceed 63dB(A). This represents the theoretical highest level of noise predicted at the most affected receptor considering an unrealistic assumption of all construction activities to be occurring concurrently.

This assessment has modelled construction noise considering the construction phases independently and concurrently, the predicted noise levels during the loudest stages of construction at nearby receptors exceed the Noise Affected criteria of 50 dB(A) but comply with the Highly Noise Affected criterion of 75 dB(A). Therefore, it is recommended that reasonable and feasible mitigation measures such as those presented in Section 4 of this report are implemented to reduce the noise impact at all receptors.

Table 6: Predicted Construction Noise Levels at Sensitive Receptors (Individual Construction Phase Assessment)

Receptor	Standard Hours Criteria		Construction Phase						
	Noise Affected	Highly Noise Affected	Project establishment, construction of fencing, drainage & roads	Concrete footing installation	Delivery and installation of cabling	Steel platform installation	BESS and inverter container installation including electrical	Control room building and Demobilisation.	Decommissioning of BESS infrastructure
R1	50	75	57	49	53	48	56	56	67
R2	50	75	56	48	52	46	55	54	66
R3	50	75	57	49	52	47	55	55	66
R4	50	75	56	49	52	47	55	55	66
R5	50	75	53	45	49	43	52	51	63
R6	50	75	53	45	49	43	51	51	62
R7	50	75	50	42	46	40	48	48	59
R8	50	75	49	41	45	39	48	47	58
R9	50	75	50	42	45	40	48	48	59
R10	50	75	47	39	43	37	46	46	57
R11	50	75	49	41	45	39	48	47	58
R12	50	75	49	41	45	39	48	47	59
R13	50	75	46	38	42	36	45	45	56
R14	50	75	47	39	43	37	46	45	56
R15	50	75	48	40	44	38	47	46	58
R16	50	75	48	40	44	38	47	46	58
R17	50	75	46	39	42	37	45	45	56
R18	50	75	47	39	43	38	46	46	57
R19	50	75	48	40	43	38	46	46	57
R20	50	75	47	39	43	37	45	45	56
R21	50	75	47	39	43	37	46	46	57

Table 7: Concurrent Construction Phase Assessment

Receptor	Standard Hours Criteria		Construction Phase				
	Noise Affected	Highly Noise Affected	Project establishment, construction of fencing, drainage & roads + Concrete footing installation	Concrete footing installation + Delivery and installation of cabling	Delivery and installation of cabling + Steel platform installation	Steel platform installation + BESS and inverter container installation including electrical	BESS and inverter container installation including electrical + Control room building and Demobilisation
R1	50	75	58	55	54	57	59
R2	50	75	57	54	53	56	58
R3	50	75	57	54	53	56	58
R4	50	75	57	54	53	56	58
R5	50	75	54	51	50	52	55
R6	50	75	53	50	50	52	54
R7	50	75	50	47	47	49	51
R8	50	75	49	46	46	48	50
R9	50	75	50	47	46	49	51
R10	50	75	48	45	44	47	49
R11	50	75	49	46	46	48	50
R12	50	75	50	46	46	48	51
R13	50	75	47	44	43	46	48
R14	50	75	47	44	44	46	48
R15	50	75	49	45	45	47	50
R16	50	75	49	45	45	47	49
R17	50	75	47	44	43	46	48
R18	50	75	48	45	44	47	49
R19	50	75	48	45	44	47	49
R20	50	75	47	44	44	46	48
R21	50	75	48	45	44	47	49

3.5 Assessment of Cumulative Construction Impacts

This NIA assessed the cumulative construction impacts of nearby major projects and the Gara BESS.

3.5.1 Armidale BESS – 89 Eathorpe Road, Armidale (SSD – 2515853)[a]

A NIA from Accent Environmental was completed for Armidale BESS on 24 August 2023. The Armidale BESS is located approximately 4.5 km West of the Subject Site. Review of the NIA completed for the Armidale BESS showed the closest receptor (R4) in located 930 m southeast of the Armidale BESS site and 4 km west of the Gara BESS site boundary . There are no common receptors identified in the NIAs for each BESS site.

The NIA for the Armidale BESS identified that during construction the highest level of noise during adverse weather conditions was 36 dB(A). The closest receptor considered for the Gara BESS is a further 2 km to the northwest of the identified R4. Due to the large distances (and subsequent attenuation of sound over distance) between the receptors and the relatively low levels of noise predicted at R4 it can be assumed that there will be negligible cumulative construction noise impacts.

3.5.2 Eathorpe BESS – SSD – 49505734

The Eathorpe BESS is currently preparing the EIS and at this stage no NIA is publicly available, therefore a detailed cumulative construction noise impact assessment cannot be undertaken until the noise emissions data for Eathorpe BESS becomes available.

3.5.3 Metz Solar Farm – SSD – 7931 – Bayley Park[b]

Metz solar farm has completed construction; therefore, no further assessment of cumulative construction impacts is warranted.

3.5.4 Armidale East BESS, Pint Pot Creek, NSW (SSD – 6508714)

The Armidale East BESS is currently preparing the EIS and at this stage no NIA is publicly available, therefore a detailed cumulative construction noise impact assessment cannot be undertaken until the noise emissions data for Armidale East BESS becomes available.

3.5.5 New England Solar – SSD – 9255

New England Solar is a solar and battery project being built in stages near Uralla in NSW. Stage one was completed in March of 2023, and construction of the second and final phase of the project began in February of 2025. It is expected that construction on stage two will be completed by June of 2025 and commissioning to occur at the end of 2025. As construction for the Gara BESS is expected to begin in 2027 it is expected that there will be no cumulative

[a] Noise Impact Assessment Armidale BESS – Accent Environmental (24 August 2023)

[b] Metz Solar Farm Environmental Acoustic Assessment – TTM Consulting Pty Ltd (12 January 2017)

construction impacts; therefore, no further assessment of cumulative construction impacts is warranted.

3.5.6 Petersons Solar Farm (Armidale Dangarsleigh Solar Farm)

Petersons Solar Farm has been completed; therefore, no further assessment of cumulative construction impacts is warranted.

3.5.7 Armidale Regional Landfill[c] - MP06_0220

Construction of the Armidale Regional Landfill was completed in 2019; therefore no further assessment of cumulative construction impacts is warranted.

3.5.8 Oven Mountain Pumped Hydro Energy Storage – SSI -12422997

The Oven Mountain Pumped Hydro Energy Storage project is located approximately halfway between Armidale and Kempsey, the project boundary is over 30 km away from the Gara BESS, the significant distances between the projects will cause the noise emissions to be attenuated and therefore the cumulative construction impacts of the project will be negligible.

3.5.9 Doughboy Wind Farm - SSD-64152463

The Doughboy Wind Farm project has withdrawn from the DA process and therefore is no longer currently schedules for construction, as such no further assessment of cumulative impacts is warranted.

3.5.10 Oxley Solar Farm – 914 Gara Road, Armidale – 215 MW Solar Farm and 50 MW BESS – SSD 10346

The Oxley Solar Farm owned by Oxley Solar Development Pty Ltd is to be constructed approximately 4 km south-east of the proposed Gara BESS. The Oxley Solar Farm construction phase would take between 12-18 months with a peak construction period of about 6 months.

The approximate timeline for the construction of the Oxley Solar Farm is commencement in Q3 of 2023 and operation during Q2 of 2025, however at this stage the project is yet to begin construction. The Oxley Solar Farm was considered to begin construction concurrently with the proposed Gara BESS to allow for a conservative assessment of potential cumulative construction impacts.

The Oxley Solar Farm acoustic report provide predicted construction noise levels in a range. AE considers the highest value presented in the Oxley Solar Farm acoustic assessment to allow for a conservative modelling approach (See Appendix E).

Cumulative impact of the projects was assessed at three receptors identified in both the EIS for Oxley Solar Farm and those identified within this report. Predicted receptor levels were calculated for each construction noise assessment individually then logarithmically added to reach a cumulative noise level at each respective receptor.

[c] Armidale Regional Landfill – Preliminary Environmental Assessment – AECOM (30 October 2008)

Receptors identified in Table 8 will be most affected by the cumulative impacts from both projects. Other receptors identified in this report are further away from both projects and hence less affected by the cumulative construction impact.

It can be seen when considering worst case modelling conditions from both projects the cumulative impact on common receptors falls below the noise affected criteria. During works, following best practice mitigation detailed in Section 4 and staff training regarding excessive noise from machinery use is recommended.

3.5.11 Stringybark Solar Farm – 29.9MW Solar Farm – DA 112-2019

The Stringy Bark solar farm acoustic report prepared by TTM consulting shares a single common receptor with the Gara BESS. The construction noise assessment prepared by TTM presents the construction noise assessment as duration above of impact above the Noise affected criteria (50 dB(A)). For the common receptor identified as NSR4 (TTM Acoustic Assessment) no values are presented. To reflect a conservative cumulative assessment of construction noise AE considered 50 dB(A) at NSR4 during all construction phases.

Receptors identified in Table 9 will be most affected by the cumulative impacts from both projects. Other receptors identified in this report are farther away from the cumulative impacts of the projects and hence less affected by the cumulative construction impacts. It is noted that as no specific values of construction noise are detailed within the TTM acoustic assessment the use of 50 dB(A) represents the most conservative modelling approach and actual construction noise is likely to be lower than values presented in Table 8.

3.5.12 Olive Grove Solar Farm - DA-112-2019

Olive Grove Solar Farm Pty Ltd propose a 29.9 MW solar farm that will connect to the national electricity grid via a substation located adjacent to an existing essential energy 66kV distribution line. The proposed location of the Olive Grove Solar Farm is located at 1060 Grafton Road and is approximately 1.6 km south-west of the Subject Site.

The Olive Grove Solar Farm does not have a publicly available NIA; therefore, a detailed cumulative construction noise impact assessment cannot be undertaken until the noise emissions data for Olive Grove Solar Farm becomes available.

Table 8: Predicted Noise Levels at Sensitive Receptors for Cumulative Construction Assessment – Oxley Solar Farm and Gara BESS

Receptor	Standard Hours Criteria		Predicted Cumulative Construction Noise (Oxley Farm and Gara BESS)					
	Noise Affected	Highly Noise Affected	Project establishment, construction of fencing, drainage & roads	Concrete footing installation	Delivery and installation of cabling	Steel platform installation	BESS and inverter container installation including electrical	Control room building and Demobilisation.
R7	50	75	49	41	45	40	47	46
R9	50	75	47	45	45	45	46	46
R11	50	75	50	46	48	46	48	48

a) Oxley Solar Farm Noise levels taken from "Construction & Operational Noise & Vibration assessment" – Prepared by NGH – 22 February 2021

Table 9: Predicted Noise Levels at Sensitive Receptors for Cumulative Construction Assessment –Stringybark Solar Farm and Gara BESS

Receptor	Standard Hours Criteria		Predicted Cumulative Construction Noise (Stringybark Solar Farm and Gara BESS)					
	Noise Affected	Highly Noise Affected	Project establishment, construction of fencing, drainage & roads	Concrete footing installation	Delivery and installation of cabling	Steel platform installation	BESS and inverter container installation including electrical	Control room building and Demobilisation.
R20	50	75	52	50	51	50	51	51

a) Stringybark Solar Farm Noise levels taken from "Acoustic Assessment – Stringybark Solar Farm" – Prepared by TTM – 14 August 2019
b) Stringybark Solar Farm construction levels assumed at 50 dB during all construction phases.

4 RECOMMENDED NOISE MITIGATION MEASURES

4.1 Mitigation of Construction Noise Levels

The nearest and most affected receptors to the east are elevated in relation to the development footprint and the use of permanent or temporary acoustic barriers at source is not considered feasible. Potential controls available to the construction contractor to minimise potential impacts for construction works could include:

- Implement community consultation or notification measures;
- Train workers and contractors on the best practice use of equipment and work methods in order to minimise noise.
- Ensure workers and contractors are aware of noise management requirements in approvals consents or licenses, site inductions and "toolbox talks" providing a summary of relevant to the Project requirements for reference;
- Include appropriate clauses and conditions within tenders, employment contracts, sub contractor agreements and work method statements that require all workers and contractors to observe (noise management) directions from their site manager.
- Inform all vehicles and mobile plant equipment of designated vehicle routes, parking locations and acceptable delivery hours or other relevant practices, such as minimising use of engine brakes and avoiding engine idling;
- Periodically check the site, nearby residences and other sensitive land uses to proactively identify noise issues and feasible and reasonable mitigation (verification)
- Limiting the type and scale of concurrent activities undertaken close to sensitive receptors where possible;
- Using broad band reversing alarms on all mobile plant and equipment if practical;
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Operating plant in a quiet and efficient manner;
- Reduce throttle setting and turn off equipment when not being used; and
- Regularly inspect and maintain equipment to ensure it is in good working order including checking the condition of mufflers.
- Validation of noise levels during construction at nearest sensitive receptors
- A full, detailed and specific CNVMP must be prepared prior to commencing works on site, once a developer is appointed and detailed construction methodology is known.

It is recommended that during any work generating high noise levels that have impulsive, intermittent, low frequency or tonal characteristics, consultation with sensitive receptors occurs regularly.

As highest predicted noise levels do not exceed the highly affected noise criteria of 75 dB(A) at any receptor, the implementation of additional noise controls (except those listed above) is not

considered necessary. During works, following best practice mitigation detailed above and staff training regarding excessive noise from machinery use is recommended.

4.2 Construction Noise Management Plan

As predicted construction noise levels are expected to be above the "Noise Affected" management goals, AE has provided a schedule of appropriate noise control recommendations and proposed inclusions for Construction Noise and Vibration Management Plan (CNVMP), to assist in mitigating noise impacts from construction stages.

All feasible noise controls and management practises detailed in this report should be adopted as initial controls as the noise emissions exceed the noise management levels. In addition to the best practice noise mitigation practices, the following additional management measures are recommended to assist in managing community disturbance during construction.

Table 8 provides a description of each of the additional measures. Additional Mitigation measures outlined in Table 8 may be applied where noise levels may still exceed noise management levels. It is noted that it is predicted that construction activities are expected to exceed the highly affected noise management levels during any period, and as such measures such as respite offers, and alternative accommodation may be deemed necessary based on community consultation and engagement over construction works timing.

Table 10: Additional Mitigation (RMS, 2016)

Mitigation Measure	Description
Notification (N) (letterbox drop or equivalent)	Advanced warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activity, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.
Specific notifications (SN)	Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops.
Phone calls (PC)	Phone calls detailing relevant information made to identified/affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.
Individual briefings (IB)	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met with individually then an alternative form of engagement should be used.
Respite Offers (RO)	Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each

	block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis and may not be applicable to all projects.
Respite Period 1 (RI)	Out of hours construction noise in out of hours period 1 shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and no more than 6 evenings per month.
Duration Respite (DR)	Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly.
Alternative Accommodation (AA)	Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels. The specifics of the offer will be identified on a project-by-project basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.
Verification (V)	Please see Appendix F of the Construction Noise and Vibration Guideline (2016) for more details about verification of Noise and Vibration levels as part of routine checks of noise levels or following reasonable complaints. This verification should include measurement of the background noise level and construction noise. Note this is not required for projects less than three weeks unless to assist in managing complaints.

Table 11 provides a summary of the noise management measures recommended for each activity for each receptor for the standard construction hours.

Construction activities inherently generate noise, but it is accepted that some level of noise is necessary to ensure continued development of our regions. It is noted that the ICNG states that selecting reasonable measures involves judging whether the overall noise benefits from a feasible option outweigh the overall adverse social, economic and environmental effects. Consideration needs to be made of the relatively short construction period, the long-term benefits establishment of the BESS has for the community.

Table 11: Recommended Management Measures for each Receptor during Standard Hours

Receptor	Management Measured by Activity						
	Project preparation and construction of acoustic wall and ancillary infrastructure	Concrete footing installation and cable installation	Delivery and installation of cabling	Steel platform installation	BESS and inverter container installation including electrical works	Control room building and demobilisation	Decommissioning of BESS infrastructure
R1	N, R1, DR, V	-[a]	N, R1, DR, V	-[a]	N, R1, DR, V	N, R1, DR, V	V, N, R1, DR
R2	N, R1, DR, V	-[a]	N, R1, DR, V	-[a]	N, R1, DR, V	N, R1, DR, V	V, N, R1, DR
R3	N, R1, DR, V	-[a]	N, R1, DR, V	-[a]	N, R1, DR, V	N, R1, DR, V	V, N, R1, DR
R4	N, R1, DR, V	-[a]	N, R1, DR, V	-[a]	N, R1, DR, V	N, R1, DR, V	N, R1, DR, V
R5	N, R1, DR, V	-[a]	-[a]	-[a]	N, R1, DR, V	N, R1, DR, V	N, R1, DR, V
R6	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R7	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R8	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R9	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R10	-[a]	N, R1, DR, V	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R11	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R12	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R13	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R14	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R15	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R16	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R17	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R18	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R19	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R20	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V
R21	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	N, R1, DR, V

a) Below the "noise affected" criteria and requires no additional noise management controls

4.3 Recommended Operational Mitigation

To achieve compliance the following mitigation measures are recommended:

4.3.1 Acoustic Barriers

Acoustic barriers are proposed as shown in Figure 3. In order to be effective, the acoustic barrier would need to be free of gaps and be constructed of material with a mass density greater than or equal to 12 kg/m2 excluding structural components.

Two acoustic barriers are to be constructed surrounding each of the two high voltage transformers located in the southeastern portion of the Subject Site. The barriers are to be constructed with a height of 3.50 m. The acoustic barriers enclose the high voltage transformers on three side, with the western face open. The approximate length of each acoustic barrier is 70 m in total.

4.3.2 Arrangement of BESS Infrastructure

- Placement of the MVPS equipment as discussed with ACEnergy, MVPS "AC Side" of all units to be facing north to help with directionality of loudest side away from sensitive receptors.
- Placement of the MVPS equipment will have the "air outlet" side facing the west in all instances to help with directionality of second loudest side away from sensitive receptors
- BESS units arranged in single columns will have the chiller facing west to help with directionality of loudest side away from closest sensitive receptors.
- BESS equipment oriented such that loudest façade (i.e., chiller façade) is directed towards the west, it is noted that the BESS units that are side by side are alternating with the chiller side on the west in the first column and units in the second column having the chiller on the east side as recommended by the manufacturer.

4.3.3 Fan Duty Restriction

- The CATL ENERX battery units have considered a maximum fan duty of 79.5% during all periods, it is noted the technical data demonstrates the fan duties can operate at a louder operating condition of 90% fan duty. Based on recommendations from the manufacturers it was determined the Subject Site could operate at full capacity while restricting fan duty to 79.5%.

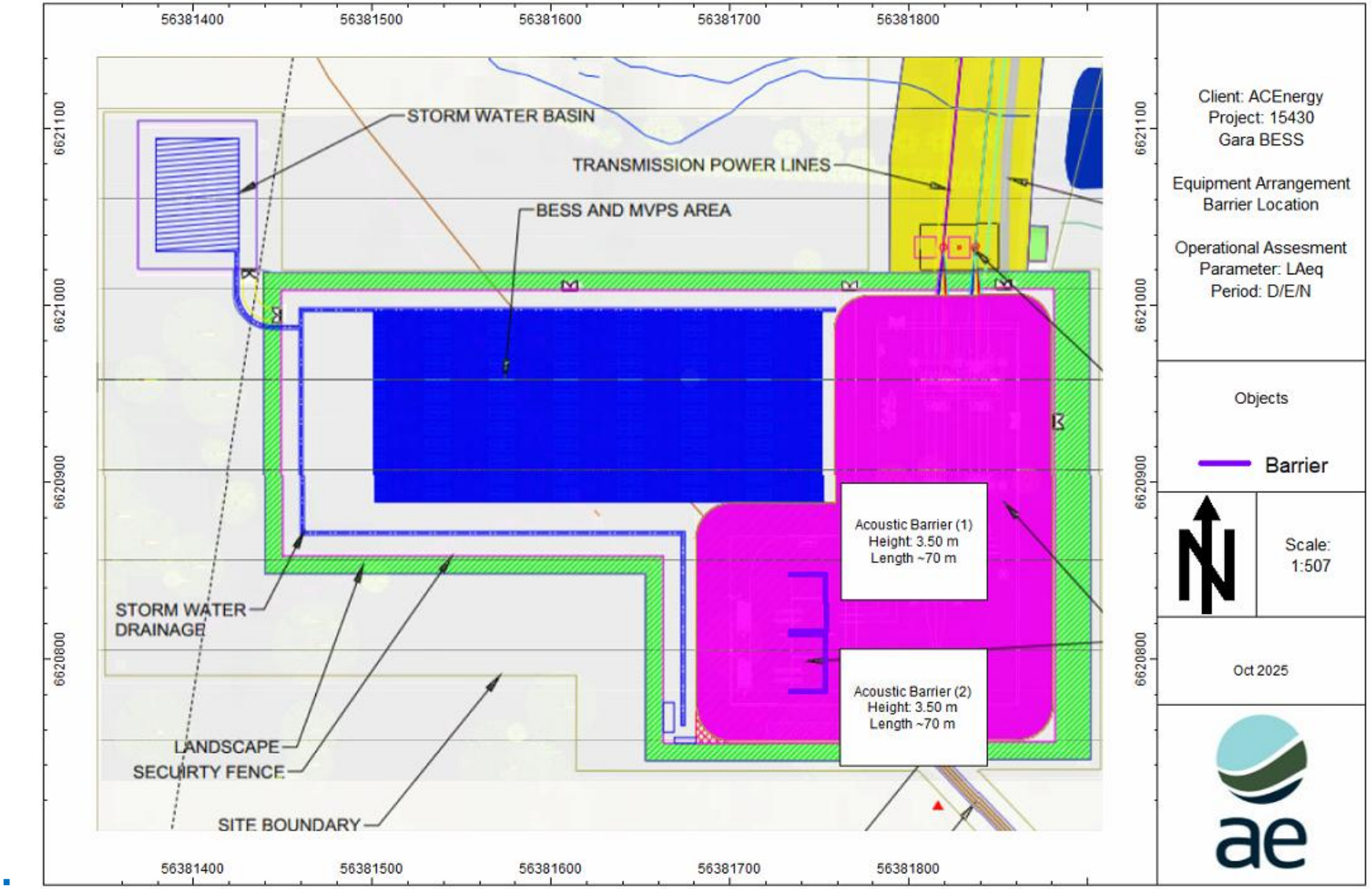

Figure 3: Barrier Locations

5 OPERATIONAL NOISE ASSESSMENT

5.1 Operational Noise Criteria

5.1.1 Overview

The acoustic assessment has been completed in accordance with the procedure identified in the NPfI. The NPfI recognises that scientific literature has identified that both the increase in noise level above background levels (that is, intrusiveness of a source), as well as the absolute level of noise are important factors in how a community will respond to noise from industrial sources.

In response to this, the NPfI establishes two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These two criteria are then used to determine project triggers levels against which the proposed development will be assessed. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response.

The derivation of the two sets of criteria are presented in Table 12. For residential dwellings, the noise criteria are assessed at the most-affected point (i.e. highest noise level) on or within the property boundary. Where the property boundary is more than 30 metres from the house, then the criteria applies at the most-affected point within 30 m of the house.

5.1.2 Intrusiveness Noise Criteria

The project intrusiveness noise level is intended to protect against significant changes in noise levels as a result of industrial development. To achieve this, the NPfI describes intrusive noise as noise that exceeds background noise levels (as defined by the Rating Background Level or RBL) by more than 5 dB.

Given the rural location of the site, the impact assessment has assumed baseline noise levels equivalent to the minimum background noise levels provided in the NPfI. Therefore, Table 12 presents the derivation of the intrusiveness criteria based on the minimum background noise level established by the NPfI.

Table 12: Derived Intrusiveness Noise Criteria

Receptor	Intrusiveness $L_{Aeq,15\text{-minute}}$ Criteria		
	Day	Evening	Night
All nearby residential receptors [a)]	40 [b)]	35 [b)]	35 [b)]

a) Receptor noise criteria applied at a location 30 m from the dwelling façade.
b) Minimum background noise level established by the NPfI 2017 + 5 dB.

5.1.3 Amenity Criteria

The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Table 13 presents the amenity noise criteria as defined by the NPfI.

Table 13: NPfI Amenity Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dB(A))	
			Total Industrial Noise	Project Specific
Residence	Rural	Day	50	50
		Evening	45	45
		Night	40	40

5.1.4 Project Trigger Levels

The project trigger level (i.e. the noise criteria considered by the assessment) is the lower value of the project intrusiveness noise level and the project amenity level, after the conversion to $L_{Aeq,\ 15\ min}$ dB(A) equivalent level. Table 14 presents the standardised intrusiveness noise level and the project amenity level as derived by adding 3 dB to each period of the day.

Table 14: Determining Project Trigger Level

Time of Day	Standardised $L_{Aeq,\ 15\ min}$ Noise Level (dB)		
	Intrusiveness Criteria	Project Specific ANL	Project Trigger Level
Day	40	50 + 3 = 53	40
Evening	35	45 + 3 = 48	35
Night	35	40 + 3 = 43	35

5.1.5 Sleep Disturbance

NSW EPA have identified a screening assessment for sleep disturbance based on the night-time noise levels at a residential location. Where noise levels at a residential location exceed:

- $L_{Aeq,\ 15\ min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 whichever is the greater, a detailed maximum noise level event assessment should be undertaken.

As discussed in Section 5.5 the predicted noise levels at residential locations do not exceed 40 dB(A) $L_{Aeq,\ 15\ min}$, therefore a detailed sleep disturbance assessment is not required. Further, given the noise sources associated with the operation of the BESS are all continuous. As such, consideration of compliance against the L_{AFmax} sleep disturbance criteria is unwarranted.

5.2 Noise Modelling Methodology

For the purposes of predicting impacts associated with noise emissions from the Subject Site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software CadnaA (2024 build 203.5403) developed by DataKustik. CadnaA incorporates the influence of meteorology, topography, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with CONCAWE.

The model is utilised to assess the potential noise emissions from the Subject Site under a range of operating scenarios and meteorological conditions. The noise modelling also allows investigation of possible noise management solutions, in the event that non-compliance with the assessment criterion is predicted.

The NPfI presents guidelines for the consideration of meteorological effects on noise propagation, specifically, temperature inversions and/or gradient winds. NPfI provides two options for assessing meteorological effects as detailed in Table 15.

5.3 Meteorology

Noise levels were predicted using the CONCAWE propagation methodology, which incorporates the influence of meteorological conditions on the propagation of noise through the atmosphere. The modelled meteorological parameters shown in Table 15 were selected to predict the worst-case noise levels at all receptors during all seasons and all time periods.

Table 15: Model Parameters

Parameter	Day (Noise-Enhancing)	Evening (Noise-Enhancing)	Night (Noise-Enhancing)
Temperature	20°C	10°C	10°C
Relative Humidity	75%	75%	75%
Wind Speed (m/s)	3.0	3.0	2.0
Stability Class	D	D	F
Wind Direction:	Worst Case	Worst Case	Worst Case

5.4 Model Configuration

Table 16 summarises the model configuration used for the modelling.

Table 16: Model Configuration

Parameter	Approach
Standards	CONCAWE
Time Periods	Day (07:00 - 18:00 hours) Evening (18:00 - 22:00 hours) Night (22:00 - 07:00 hours)
Digital Topography	LIDAR data at 5 m intervals.
Ground Absorption	Based on aerial mapping. development footprint, ground absorption set to 0.1, surrounding rural areas ground absorption set to 1.0.
Meteorology	Day and Evening: Stability class D at 3 m/s Night: Stability class F at 2 m/s Worst case wind direction (source to receptor)

5.5 Noise Sources

It is understood that the equipment and associated noise level data used as the basis for this assessment will be comparable with the final selections for the proposed facility. The primary recommendation will be that a suitably qualified acoustic consultant is engaged during detailed design to ensure that compliance with relevant criteria is achieved at nearby noise sensitive receptors. Should equipment with lower sound power level information than adopted, then the nominated noise control strategies may be amended with approval by a suitably qualified acoustic consultant.

All noise sources associated with BESS are considered continuous in nature and are associated with fixed plant items operating in the charging and distribution process. Where annoying noise characteristics have been identified the adjustment has been included in the L_{Aeq} column. The sound power levels have been taken from the following sources.

- BESS noise data taken from manufacturers noise testing data-sheet [d]. The battery energy storage system technology considered for this report is the CATL ENERX containerised battery energy storage system.
- BESS equipment oriented such that loudest façade (i.e., chiller façade) is directed towards the west, it is noted that the BESS units that are side by side are alternating with the chiller side on the west in the first column and units in the second column having the chiller on the east side as recommended by the manufacturer.
- 1/3 octave spectral data for batteries provided by manufacturers technical datasheet.
- MVPS (Medium Voltage Power Station) equipment oriented such that loudest façade (i.e., AC outlet) is directed north. The MVPS consists of one SMA SCS-4600-UP-S Inverter and one 5 MVA transformer
- 1/3 octave spectral data for inverters were obtained from Manufacturers technical datasheet [e].
- 1/3 octave spectral data for transformers were taken from the Australian Acoustical Society[f].
- Site specific topography for post development levels applied in computational modelling.
- A review of tonality was assessed with respect to procedures detailed in the NPfI, computational modelling did not predict tonal characteristics to be present at sensitive receptors; therefore, additional tonal corrections were not applied to the sources.
- A review of low frequency noise was assessed with respect to procedures detailed in the NPfI. AE's review of 1/3 octave spectral data did not predict annoying low frequency characteristics to be present; therefore, additional corrections were not applied to the sources.

d Manufacturers technical test report – EnerX 0.25 40kw water cooling unit, Report No. CAIT-VI-250139-E– Contemporary Amperex Intelligence Technology – Co, limited Test Center – 09/04/2025

e Testlab Document – TR EMC SCS/3950UP-XT Acoustic – SMA Solar Technology – 30/01/2024

f Paper Number 23, Proceedings of ACOUSTICS 2011: Low-frequency and Tonal Characteristics of Transformer Noise: Prepared by Michael Gange November 2011

Table 17: Noise Sources

Equipment	Noise Source	Qty	Height (m)	Usage Period (%)			Sound Power Level (dB(A))		Noise Characteristics (as per the NPFI) [c]
				Day	Evening	Night	L_{Aeq}	L_{Amax}	
MVPS (Medium Voltage Power Station) [a] Inverter Container with Sound Proofing SCS-4600-UP-S Inverter	MVPS Inverter (Top façade)	112	2.90	100	100	100	59[a]	n/a	None
	MVPS Inverter (Front façade)	112	2.90	100	100	100	76[a]	n/a	None
	MVPS Inverter (Back façade)	112	2.90	100	100	100	71[a]	n/a	None
	MVPS Inverter (AC inlet Side)	112	2.90	100	100	100	68[a]	n/a	None
	MVPS Inverter (AC outlet Side)	112	2.90	100	100	100	70[a]	n/a	None
MVPS Internal Transformer (4 MVA)	MVPS internal transformer (Top façade)	112	2.90	100	100	100	76	n/a	None
	MVPS Transformer (Side façades)	112	2.90	100	100	100	76	n/a	None
CATL ENERX BESS (Battery Energy Storage System) [b]	BESS Front side	336	2.90	100	100	100	57	n/a	None
	BESS Front side (Chiller)	336	2.90	100	100	100	72	n/a	None
	BESS Back side	336	2.90	100	100	100	62	n/a	None
	BESS Left side (chiller)	336	2.90	100	100	100	83	n/a	None
	BESS Right side	336	2.90	100	100	100	51	n/a	None
320 MVA Transformer[(c)]	225 MVA Transformer	2	2.00	100	100	100	96[d]	n/a	None

a) Datasheet provides sound pressure level at 0.2 m at each of the different facades Log average of values represented at various measurement points along each façade were used in calibration. Model was calibrated so each façade produced a sound pressure level at 0.2 m as described in table 17.

b) Datasheet for BESS equipment provides sound pressure levels at 1 m distance at each façade. The model was calibrated so each façade produced a sound pressure level at 1 m as described in the manufacturers data sheet, 29 distinct points were used for calibration. This model considers the BESS to be operating under a 79.5% fan duty during all periods.

c) Annoying noise characteristics (tonality, low frequency noise) were assessed with respect to the procedures of the NPfI (at the receptor) and demonstrated that no additional tonal corrections were required.

d) It is noted that should transformers with a lower sound power level be considered in detailed design, compliance can be achieved at all receptors without the necessity of acoustic barriers surrounding the high voltage transformers.

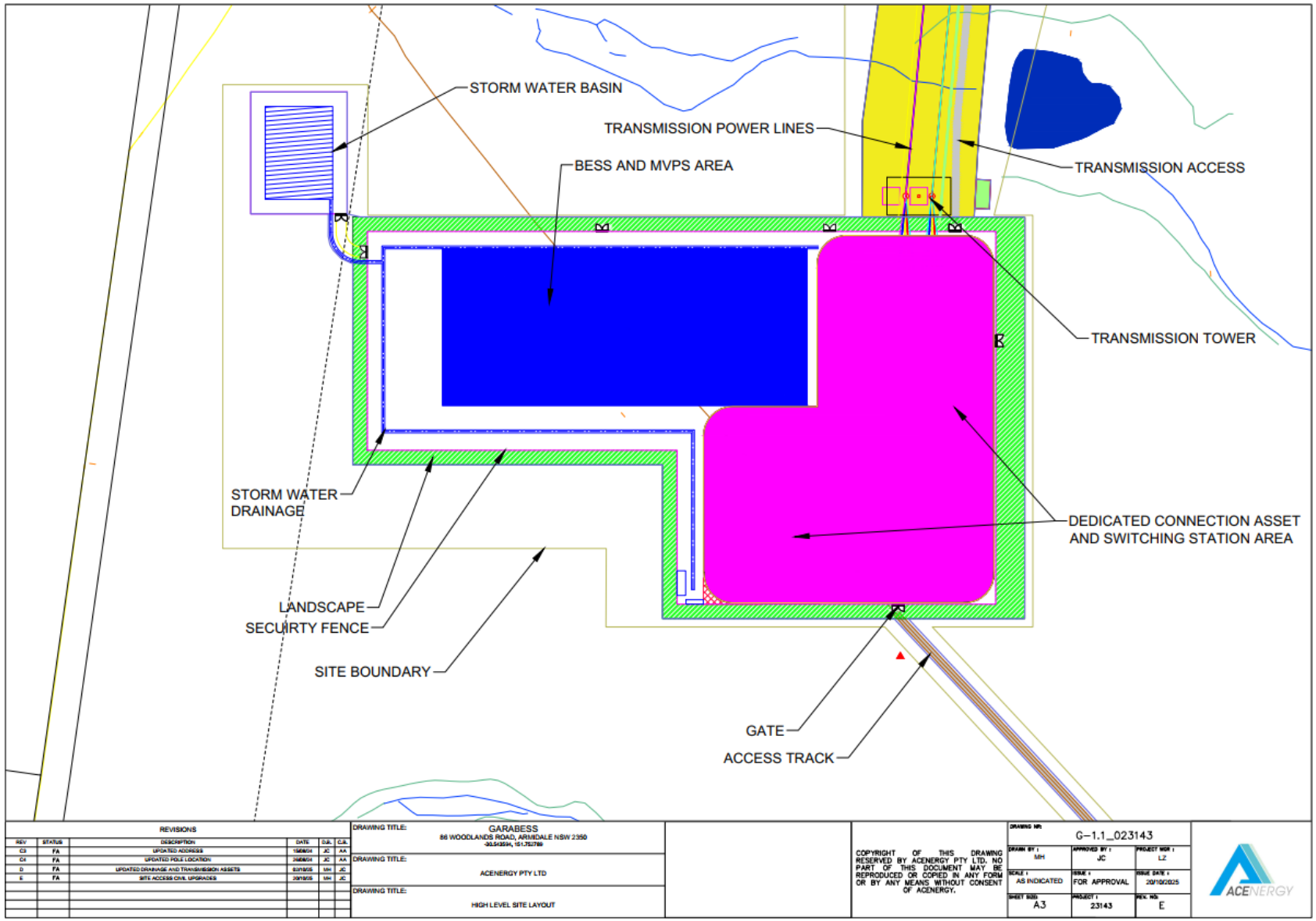

Figure 4: Equipment Locations

5.6 Predicted Operational Noise Levels

An operational noise assessment was performed on the Subject Site considering noise emissions with noise mitigation measures outlined in Section 4.

The findings of this assessment rely on the equipment sound power levels presented in Table 17. Alternative equipment selections may be considered where the sound power levels are the same or lower than those used in this assessment.

Table 18 presents the predicted operational noise emissions. Detailed noise contours for acoustic emissions without noise mitigation can be found in Appendix B.

Table 18: Predicted Receptor Noise Levels without Mitigation - Operational Phase

Receptor	Predicted Operational Noise Levels, $L_{Aeq, 15min}$			Intrusive Noise Criteria (dB(A))			Comply (Y/N)
	Day	Eve	Night	Day	Eve	Night	
R01	31	31	31	40	35	35	Y | Y | Y
R02	31	31	31	40	35	35	Y | Y | Y
R03	30	30	30	40	35	35	Y | Y | Y
R04[a)]	32	32	32	-	-	-	Y | Y | Y
R05	24	24	24	40	35	35	Y | Y | Y
R06	27	27	27	40	35	35	Y | Y | Y
R07	19	19	19	40	35	35	Y | Y | Y
R08	22	22	22	40	35	35	Y | Y | Y
R09	17	17	17	40	35	35	Y | Y | Y
R10	<10	<10	<10	40	35	35	Y | Y | Y
R11	16	16	16	40	35	35	Y | Y | Y
R12	20	20	20	40	35	35	Y | Y | Y
R13	<10	<10	<10	40	35	35	Y | Y | Y
R14	<10	<10	<10	40	35	35	Y | Y | Y
R15	<10	<10	<10	40	35	35	Y | Y | Y
R16	13	13	13	40	35	35	Y | Y | Y
R17	<10	<10	<10	40	35	35	Y | Y | Y
R18	<10	<10	<10	40	35	35	Y | Y | Y
R19	<10	<10	<10	40	35	35	Y | Y | Y
R20	<10	<10	<10	40	35	35	Y | Y | Y
R21	<10	<10	<10	40	35	35	Y | Y | Y

a) R04 is associated with the Subject Site and does not need to be considered in assessment of sensitive receptors, compliance would be achieved with residential receptor criteria regardless.

Review of the predicted noise levels with noise mitigation measures applied confirms that compliance with the noise criteria established in accordance with the NPfI can be achieved for all receptors for all assessment periods under worst-case meteorological conditions.

5.7 Predicted Cumulative Operational Noise Levels

5.7.1 Armidale BESS – 89 Eathorpe Road, Armidale (SSD – 2515853)

AE completed a review of NIA completed for Armidale BESS It is shown in the operational assessment of Armidale BESS that there are no common receptors identified between the Subject Site and Armidale BESS.

Of the receptors identified for the Armidale BESS the closest receptor (identified as R4 in the Armidale BESS NIA) expects a maximum of 36 dB(A) during adverse weather conditions. This receptor is located 930m from the Armidale BESS site and is a further 4km west of the Subject Site boundary. Given significant distances between the receptors and the relatively low levels of noise predicted at R4 it can be assumed that there will be negligible cumulative operational noise impacts, due to the attenuation of noise over distance.

5.7.2 Eathorpe BESS – SSD – 49505734

The Eathorpe BESS is currently in the EIS submissions process and at this stage no NIA is publicly available, therefore a detailed cumulative operational noise impact assessment cannot be undertaken until the noise emissions data for Eathorpe BESS becomes available.

5.7.3 Metz Solar Farm – SSD – 7931 – Bayley Park

The distance between the Metz Solar Farm and the Subject Site is greater than 10 km. There are no common receptors. During operation the solar farm predicts 36 dB(A) at the closest noise sensitive receptors. As there are large distances between the Subject Site and the Metz Solar Farm the cumulative noise will be significantly attenuated by distance, as such no further investigation of cumulative operational noise impacts is warranted.

5.7.4 Armidale East BESS, Pint Pot Creek, NSW (SSD – 6508714)

The Armidale East BESS is currently in the EIS submissions process and at this stage no NIA is publicly available, therefore a detailed cumulative operational noise impact assessment cannot be undertaken until the noise emissions data for Armidale East BESS becomes available

5.7.5 New England Solar – SSD – 9255[9]

The New England Solar Farm does not share any common receptors with the Gara BESS Subject Site. The receptors closest identified as C5 and N1 are closest to the Gara BESS Subject Site. These receptors are not expected to receive operational noise levels of noise higher than 40 dB(A) during the day and 35 dB(A) during the night and evening.

The distance between the receptors identified in the New England Solar and Battery NIA is over 10 km away from the closest sensitive receptor identified for the Gara BESS NIA, as such it can be assumed there will be significant levels of attenuation over this distance. Therefore, it can be

[9] New England Solar Farm Noise and Vibration Impact Assessment – EMM consulting (16 November 2018)

assumed that the cumulative noise impacts will be negligible due to the relatively low levels of predicted sound at the New England solar premises and the significant distances between the sites.

5.7.6 Petersons Solar Farm (Armidale Dangarsleigh Solar Farm)

The Petersons Solar Farm is over 7 km in distance from the boundary of the Gara BESS NIA. Further given the Solar farm is a 5 MW solar Farm with relatively small scale, it can be assumed the operational noise emissions are relatively small. The distance between the Subject Site and Petersons Solar Farm is significant and hence it can be assumed there will be significant levels of attenuation over this distance. Therefore, it can be assumed that the cumulative operational noise impacts will be negligible due to the relatively small scale of Petersons Solar Farm and the distance between the two sites.

5.7.7 Armidale Regional Landfill[h] - MP06_0220

The EIS prepared for the Armidale regional landfill provides predicted operational levels during adverse meteorological conditions. Review of the EIS demonstrated that the Gara BESS shared common noise sensitive receptors with the Armidale regional landfill, as such a quantitative assessment of cumulative operational impacts was undertaken. The results of the cumulative operational assessment are demonstrated in Table 19

The operational noise produced from the Armidale regional landfill during adverse meteorological conditions dominate the noise emissions predicted at the common receptors. It is further noted that the noise emissions considered in the Armidale regional landfill are above the established noise criteria for the evening and night assessment periods. The cumulative operational emissions are above the assessment criteria during the evening and night periods; however, these noise emissions are dominated by emissions generated at the regional landfill.

Exceedances of the operational criteria are caused by noise emissions generated at the Armidale regional landfill. The cumulative impact of the Subject Site on common receptors is expected to be <1 dB greater than the levels the receptors are currently receiving as a result of the operation of the Armidale Regional Landfill. The NPfI considers an increase of noise between 0-2 dB(A) as negligible and not perceptible by the average listener. As such the cumulative impacts of the Subject Site are considered to be negligible and further mitigation of noise emissions generated at the Gara BESS are not warranted.

5.7.8 Oven mountain pumped hydro Energy Storage – SSI-12422997

The Oven Mountain Pumped Hydro Energy Storage project is located approximately halfway between Armidale and Kempsey, the project boundary is over 30 km away from the Gara BESS, during the operational phase the large distance between the sites and the relatively low operational emissions expected from the facility (< 35 dB(A)) at any given receptor mean the cumulative impacts are considered to be negligible and no further assessment is warranted.

[h] Armidale Regional Landfill – Preliminary Environmental Assessment – AECOM (30 October 2008)

5.7.9 Doughboy Wind Farm – SSD-64152463

The Doughboy Wind Farm project has withdrawn from the DA process and therefore is no longer currently schedules for construction, as such no further assessment of cumulative impacts is warranted.

5.7.10 Oxley Solar Farm – 914 Gara Road, Armidale – 215 MW Solar Farm and 50 MW BESS – SSD 10346

An Environmental Impact Statement (EIS) has previously been completed for Oxley Solar Farm as part of the development approvals process. The noise component of the EIS completed by NGH[i] included an operational noise assessment for Oxley Solar Farm.

The operational noise assessments were independently conducted for Oxley Solar Farm and Gara BESS in which the worst-case meteorological conditions were used in assessment. These values were used to assess the cumulative operational impact from both projects.

The Noise Impact Assessment was accepted in the approved EIS for the Oxley Solar Farm and therefore the predicted receptor levels are taken to be valid. AE has used these levels in the cumulative assessment for both projects.

Cumulative impact of the projects was assessed at three receptors identified in both the EIS for Oxley Solar Farm and those identified within this report. Predicted receptor levels were calculated for each operational assessment individually then logarithmically added to reach cumulative noise level at each respective receptor.

Receptors identified in Table 15 will be most affected by the cumulative impacts from both projects. Other receptors identified in this report are further away from both projects and hence less affected by the cumulative operational impact. Compliance found at receptors identified in both reports will imply compliance at all other sensitive receptors.

Table 15 demonstrates that under worst case meteorological conditions the cumulative assessment for Oxley Solar Farm and the Gara BESS finds the receptors to be compliant with applicable criteria.

5.7.11 Olive Grove Solar Farm – DA17-2020

Olive Grove Solar Farm Pty Ltd propose a 29.9 MW solar farm that will connect to the national electricity grid via a substation located adjacent to an existing essential energy 66V distribution line. The proposed location of the Olive Grove Solar Farm is located at 1060 Grafton Road and is approximately 1.6 km south-west of the Subject Site.

The Gara BESS and the Olive Grove Solar farm share five common acoustic receptors as identified in the Olive Grove Solar Farm Acoustic Impact Assessment. It is noted that the Olive Grove Solar Farm will only produce noise during daylight hours.

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i Yanco Solar Farm: Construction & Operations & Vibration Assessment: prepared by Renzo Tonin & Associates (their Report no TJ856-01F01; dated 06 February 2019)

The Acoustic Assessment conducted by TTM Consulting for Olive Grove Solar Farm qualitatively evaluates the noise impact by identifying a suitable radius beyond which 'no impact' is expected, rather than providing quantitative noise levels at discrete sensitive receptors and/or noise contour plots. It also makes the conclusion that the noise generated from operating equipment and operational maintenance activities to be 'insignificant'. Without detailed information on individual receptor noise levels or noise contour plots, a cumulative assessment cannot be accurately completed.

5.7.12 Stringy Bark Solar Farm – DA-112-2019

The Acoustic Assessment for the Stringybark Solar Farm completed by TTM only considered the radius in which receptors would be above the minimum criteria of 40 dB(A). The TTM Acoustic Assessment noted the solar farm would be operational during the day only. The TTM report refers to the radius of operational activities as approximately 150 metres, as all there are no receivers within the development envelope or the substation footprint the TTM acoustic report predicts no impact from operational activities.

The Gara BESS and Stringybark Solar Farm share a single common acoustic receptor identified as NSR4 (Noise Sensitive Receiver 4) which is over 1.5 km from the development envelope identified in the Acoustic Assessment, no specific values have been assigned to this receptor however the operational impacts at a receiver at this distance can be considered negligible due to the attenuation of sound over distance. As such the cumulative operational impacts of the Stringybark Solar Farm can be considered negligible due to the attenuation of sound over distance.

Table 19: Cumulative Operational Assessment - Armidale Regional Landfill

Receptor as defined by AE receptor locations	Receptor as defined Armidale Regional Landfill noise impact assessment	Intrusive Noise Criteria			Operational Noise levels			Comply (Y/N)
		Day	Eve	Night	Armidale Regional Landfill Operational Impact[a]	Gara BESS Operational Impact	Cumulative Impact	
R09	R04	40	35	35	39	17	39[b]	Y | N | N
R01	R05	40	35	35	39	31	40[b]	Y | N | N
R03	R06	40	35	35	35	30	36[b]	Y | N | N

a) Noise levels taken from "Armidale Regional Landfill – Preliminary Environmental Assessment – 30 October 2008 – prepared by Maunsell Australia Pty Ltd
b) Cumulative noise levels are driven by the Armidale Regional Landfill, impacts from the Gara BESS increase noise levels by <1 dB and therefore are considered to have a negligible impact on the overall noise levels at these receptors.

Table 20: Cumulative Operational Assessment -Oxley Solar Farm

Receptor as defined by AE receptor locations	Receptor as defined Oxley Solar Farm noise impact assessment	Intrusive Noise Criteria			Operational Noise levels			Comply (Y/N)
		Day	Eve	Night	Solar Farm Operational Impact (RTA Report)[b]	Gara BESS Operational Impact	Cumulative Impact	
R07	R17	40	35	35	21	18	23	Y | Y | Y
R09	R6	40	35	35	<20[a]	15	<22	Y | Y | Y
R11	R8	40	35	35	<20[a]	14	<22	Y | Y | Y

a) Taken as a conservative value of 20dB(A) for perform calculations, actual levels are predicted to be lower by NGH NIA but are not specified.
b) Noise levels taken from "Construction & Operational Noise & Vibration assessment" – Prepared by NGH – 22 February 2021

6 ROAD TRAFFIC NOISE ASSESSMENT

6.1 Introduction

Noise impacts associated with vehicle movements during the operational phase of the BESS project are expected to be low with approximately five light vehicle movements during the AM and PM peak hour. The road traffic emissions can be considered negligible due to the low traffic volumes generated from the Subject Site during the operational phase.

During construction and establishment of the Project however, traffic movements will be more significant. Compliance with the EPA Road Noise Policy during the noisier construction period will imply compliance during the operational phase of the Subject Site

For assessment purposes, ACEnergy has provided predicted vehicle volumes during the construction phase. Construction is expected to be completed over 60 weeks (approximately 14 months), and it is anticipated a peak construction period of up to a four and half month period.

The estimated vehicle numbers provided by ACEnergy predicted an estimated peak of 43 private light vehicles and 75 heavy vehicles[j] to be travelling to and from the Subject Site daily during the peak construction phase. Predicted traffic volumes are provided in Table 21.

Table 21: Traffic Generation during Peak Construction Period

Vehicle Type	Peak Construction Period	
	Vehicle Trips Per Day (vpd)	Peak Hour Trips (vph)
Light Vehicles	43	43
Heavy Vehicles (HV)	75	11

All movements are expected to occur during standard construction hours (7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturday). For a worst-case assessment all vehicles were assessed to be travelling to site before 7am and therefore assessment against the nighttime criteria was done to account for this potential. It is assumed that during a peak traffic hour a maximum of 15% of the heavy vehicles will be on the travel route at any given time, as such 43 light vehicles and 11 heavy vehicles has been considered against the nighttime assessment criteria to account for all vehicles enroute to the Subject Site between 6am - 7 am.

Given this, the assessment has considered the potential impacts associated with noise emissions from the maximum expected 43 light (inclusive of 8 shuttle buses) and 75 heavy vehicle movements from the site entry along one possible route, being East and West along Waterfall Road.

6.2 Assessment Criteria

The DCNG does not provide criteria for the assessment of construction road traffic during the project. Given this, reference is made to the noise criteria provided in the NSW Road Noise Policy (RNP). Based on the type of roadway, Table 22 presents the applicable road traffic noise criteria

j Vehicle volumes are taken from traffic impact assessment – "Gara Battery Energy Storage System Traffic Impact Assessment" – "Appendix B" prepared by TTPP – 11 September 2024

for existing residences affected by traffic on existing roadways generated by land use developments.

Table 22: Applicable Road Traffic Noise Criteria

Road Category	Type of Project & Land Use	Assessment Criteria
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	Day: $L_{Aeq,1\ hour}$ 55 dB(A) Night: $L_{Aeq,1\ hour}$ 50 dB(A) (external)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	Day: $L_{Aeq,15\text{-}hour}$ 60 dB(A) Night: $L_{Aeq,9\text{-}hour}$ 55 dB(A) (external)

6.3 Noise Modelling Methodology

For the purposes of predicting impacts associated with road traffic noise emissions, the proprietary software CadnaA (2024 MR2 build 203.5403) developed by DataKustik was used. The model incorporates the influence of topography, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with Calculation of Road Traffic Noise (CRTN) methodology developed by the UK Department of Transport. In accordance with the requirements of the Road Noise Policy (RNP), the predictive noise modelling incorporated the following assumptions:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CRTN methodology using the approximation $L_{Aeq,1\ hour} = L_{A10,1\ hour} - 3$.
- Noise source heights were set at 0.5 m above road level for cars, 1.5 m for heavy vehicle engines and 3.6 m for heavily vehicle exhausts.
- Noise from heavy vehicle exhausts is 8 dB lower than the steady continuous engine noise; and
- Corrections established for Australian conditions applied through a negative correction to the CRTN predations of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982).

Table 23: Road Traffic Data

Road Segment	Assessment Metric	Vehicle Type	Vehicle Speed	Number of Additional Individual Movements	
				Day (7 am to 10 pm)	Night (10pm – 7 am)
Sub-Arterial Highway (15/9-hour criteria) Waterfall Road	**Daytime criteria**: $L_{Aeq,\ (period)}$ 60 (external) **Nighttime criteria:** $L_{Aeq,\ (period)}$ 55 (external)	Light	100 km/hr	43	43
		Heavy	100 km/hr	75	11

Traffic volumes along waterfall road were provided in the traffic impact assessment from TTPP. A recent survey provided in the traffic impact assessment of existing traffic volumes in 2024[k] for two-way traffic along Waterfall Road was used in computational modelling to predict existing traffic noise volumes.

Given the rural location, if the existing traffic along these roads produces a noise level below the allowable levels in Table 22, no further assessment would be warranted. It is also noted due to the large distance between residential premises and Waterfall Road potential noise impacts generated from road traffic along this route are significantly attenuated.

Where this is not the case (i.e. (R05) where existing traffic along these roads produces noise above the levels in Table 22), the RNP allows a development to generate additional traffic as long as the increase in noise levels at receptors is no more than 2 dB(A). Receptors considered can be seen in Appendix C.

AE has reviewed the traffic impact assessment prepared by TTM in 2024. The traffic impact assessment completed a survey of two-way traffic generated along waterfall road in august of 2024. The results of the survey demonstrated the state route waterfall road experienced high demands with peak two-way hourly demand recorded varied between 136 vehicles per hour and 224 vehicles per hour.

Table 24 Demonstrates the existing traffic noise predicted using traffic count data provided in the TTM TIA.

Table 24: Predicted Existing Road Traffic Noise

Sensitive Receptor	Setback from Roadway	Period	Parameter	Criteria	Predicted Noise Level[(a)]	Comply (Y/N)
(R05) Waterfall Road	40 m	Day	$L_{Aeq,15\ hour}$	60 dB(A)	64 dB(A)	N
		Night	$L_{Aeq,9\ hour}$	55 dB(A)	53 dB(A)	Y

a) Existing vehicle volumes taken from Table 3.3 of TTPP traffic impact assessment, Table 3.3 of the 2024 vehicle volume survey, Sundays were excluded from data as no construction activities occur on these days.

Table 25 demonstrates the predicted noise when considering the additional vehicles generated from the Subject Site during the peak construction phase.

Table 25: Predicted Future Road Traffic Noise

Sensitive Receptor	Setback from Roadway	Period	Parameter	Criteria	Predicted Noise Level	Comply (Y/N)
(R05) Waterfall Road	40 m	Day	$L_{Aeq,15\ hour}$	<2dB(A) Increase over existing levels	65 dB(A)	Y
		Night	$L_{Aeq,9\ hour}$		55 dB(A)	Y

Given the low traffic generated in the proposed expansion, the increase in traffic as a result of the expansion of the Subject Site would result in a negligible (< 2 dB) increase in noise at surrounding residences. The results of the road traffic assessment demonstrated that the Development

[k] Vehicle volumes are taken from traffic impact assessment – "Gara Battery Energy Storage System Traffic Impact Assessment" -Table 3.3 - prepared by TTPP – 11 September 2024

Footprint is compliance during the day as it predicts a <2 dB increase over existing road traffic noise levels. The Subject Site is in compliance with the nighttime assessment criteria for road traffic noise.

The most affected receptor R05 has the smallest setback between the road and the property façade, as such compliance with the RNP at R05 will imply compliance with all other receptors that have a larger setback to Waterfall Road. As such, AE expects compliance with the RNP is achieved in all instances.

7 VIBRATION ASSESSMENT

7.1 Introduction

A review of the proposal indicates there is potential for impacts as a result of vibration generated by plant and equipment during the construction phase. Given this, an assessment of the potential for vibration impacts has been undertaken. In particular, the assessment has considered the potential for impacts on both human comfort and structural damage for the nearest residence to the construction works.

7.2 Assessment Criteria

The vibration criteria presented in *Assessing Vibration: A Technical Guideline* (2006) published by the NSW Department of Environment and Conservation (DEC) have been adopted for the assessment. The technical guide provides vibration criteria associated with amenity impacts (human annoyance) for the three categories of vibration:

- Continuous vibration (e.g. road traffic, continuous construction activity);
- Impulsive vibration includes less than three distinct vibration events in an assessment period (e.g. occasional dropping of heavy equipment); and
- Intermittent vibration includes interrupted periods of continuous vibration (e.g. drilling), repeated periods of impulsive vibration (e.g. pile driving) or continuous vibration that varies significantly in amplitude.

Table 26 and Table 27 present the criteria for continuous and impulsive vibration and intermittent vibration, respectively.

Table 26: Continuous & Impulsive Vibration Criteria for Residences – Peak Velocity

Location	Vibration Type	Preferred Limit (mm/s)	Maximum Limit (mm/s)
Residences	Continuous	0.28	0.56
Residences	Impulsive	8.6	17

Table 27: Intermittent Vibration Criteria for Residences

Location	Assessment Period	Preferred Value (m/s1.75)	Maximum Value (m/s1.75)
Residences	Day-time	0.20	0.40

The criteria are suitable for assessing human annoyance in response to vibration levels. In order to assess potential damage to buildings, reference has been made to British Standard *BS 7385-2: 1993 Evaluation and measurement of vibration in buildings – Part 2: Guide to damage levels from ground borne vibration*. Table 28 presents vibration criteria for assessing the potential for building damage.

Table 28: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Particle Velocity (mm/s)	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures – residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

7.3 Potential Vibration Sources

Table 29 identifies the vibration source levels for the equipment likely to be used for the construction of the BESS. Piling was included as a potential source of vibration as direct driving footing, which requires piling, could be made possible depending on the soil conditions as a result of geotechnical investigation. Therefore, piling activities are included in this vibration assessment as a conservative approach.

Table 29: Vibration Source levels – Peak Particle Velocity

Equipment Item	PPV at 10 metres (mm/s)	Source
Piling (press-in method)	1 – 2	Rockhill, D.J. et. al. [b)]
Roller	5 – 6	DEC
7 tonne compactor	5 – 7	DEC
Loaded trucks (rough surface)	5	USA DT [a)]
Loaded trucks (smooth surface)	1 – 2	USA DT [a)]
Excavator	2.5 – 4	DEC

a) Transit Noise and Vibration Impact Assessment, US Department of Transportation, May 2006
b) Rockhill, D.J., Bolton, M.D. & White, D.J. (2003) 'Ground-borne vibrations due to press-in piling operations'

7.4 Assessment of Potential Impacts

Based on the vibration source levels at 10 metres (presented in Table 29), peak particle velocities have been predicted at various separation distances. The NSW DEC indicates that in predicting vibration levels, it can be assumed that the vibration level is inversely proportional to distance (with the relationship varying between $d^{-0.8}$ to $d^{-1.6}$ based on field data).

The US Department of Transportation's Transit Noise and Vibration Impact Assessment (May 2006) presents the following construction vibration propagation formula assuming an inverse relationship:

$$PPV@d_2 = PPV@d_1 \times (d_1/d_2)^{1.5}$$

where: d_1 = distance 1 (reference distance for source data) (m)

d_2 = distance 2 (separation distance for predicted PPV) (m)

PPV = peak particle velocity (mm/s)

The above formula has been considered for predicted PPVs at various distances from construction equipment. Based on the above information, Table 30 presents PPV predictions for the various construction equipment.

Table 30: Predicted Peak Particle Velocity at Sensitive Receptors (mm/s)

Distance from Source (m)	Predicted Peak Particle Velocity (mm/s)				
	Roller	7 tonne compactor	Excavator	Loaded trucks (rough surfaces)	Loaded trucks (smooth surfaces)
10	6.00	7.00	4.00	5.00	1 – 2
20	2.12	2.47	1.41	1.77	0.35 – 0.71
30	1.15	1.35	0.77	0.96	0.19 – 0.38
40	0.75	0.88	0.50	0.63	0.13 – 0.25
50	0.54	0.63	0.36	0.45	0.09 – 0.18
60	0.41	0.48	0.27	0.34	0.07 – 0.14
70	0.32	0.38	0.22	0.27	0.06 – 0.11
80	0.27	0.31	0.18	0.22	0.05 – 0.09
90	0.22	0.26	0.15	0.19	0.04 – 0.07
100	0.19	0.22	0.13	0.16	0.03 – 0.06
150	0.1	0.12	0.07	0.09	0.02 – 0.03
Type	Continuous			Intermittent	
Nuisance Criteria	Residential 0.28 (preferred) / 0.56 (max)			Residential 0.20 (preferred) / 0.40 (max)	
Building Criteria	Residential 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above				

The predicted vibration levels presented in Table 30 indicate compliance with the continuous maximum vibration nuisance criteria for locations at a separation distance of 50-60 metres. Compliance with the building damage criteria is predicted at 10 metres from construction for each source. Therefore, as the closest receptor is over 500 m from the nearest vibration source, there will be no adverse impact.

For intermittent vibration associated with haul vehicles, it is difficult to provide an appropriate comparison with the relevant criteria (which is presented as a Vibration Dose Value (VDV) in $m/s^{1.75}$). The calculation of a VDV requires both the overall weighted RMS (root mean square) acceleration (m/s^2) typically obtained from on-site measurements and the estimated time period for vibration events.

It is noted, however, that the compactor PPV at distances of 500 m (the distance to the nearest sensitive receptor from potential piling) is predicted to be within the maximum continuous criteria of 0.56 mm/s. This comparison with the continuous criteria (as a conservative approach) indicates that vibration levels associated with compactor are not considered to be significant (which is expected given the significant separation distances).

The vibration assessment demonstrates that there are no adverse amenity effects as a result of the peak construction activities or operational phase at the nearby sensitive receptors.

8 CONCLUSION

ACEnergy propose to develop a 400 MW battery energy storage system in Armidale with an overhead transmission line connecting to an existing 330 kV network. The impact assessment has considered the potential for adverse impacts resulting from noise (construction, road traffic and operational) and vibration emissions on nearby residential uses.

The assessment of potential noise impacts has considered the construction phase should occur during standard hours only. For construction during standard hours, adverse amenity impacts during construction adverse impacts are considered unlikely if best practice is followed, mitigation detailed above and staff training regarding excessive noise from machinery use is implemented

Similarly, the cumulative construction noise from the nearby state significant developments and regional development were assessed, adverse amenity impacts during the cumulative construction phase are considered unlikely as they are within 1-2dB or fall below the established "Noise affected criteria" when modelled under the most conservative conditions.

The assessment of potential impacts from road traffic and vibration emissions from the Gara BESS were conducted. During the operation phase of the projects vibration and road traffic emissions are considered negligible due to the nature of the BESS equipment and minimal staff vehicle volumes during the operational phase.

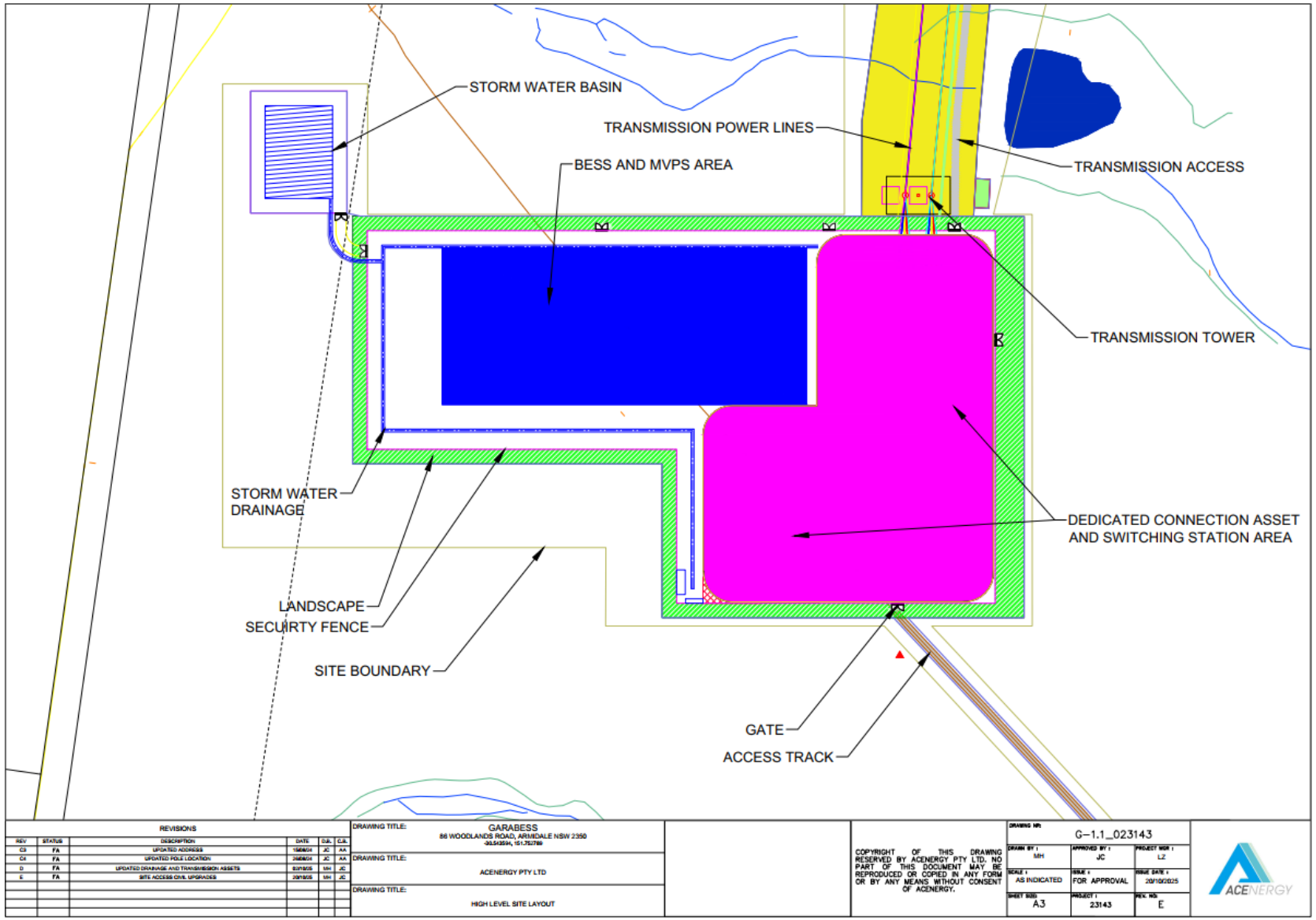
The largest potential for impact from road and vibration impacts occurs during the construction phase of the project. Detailed assessment of impacts during the construction phase identified adverse amenity impacts from road traffic and vibration emissions to be unlikely and compliance with applicable criteria is expected to be achieved.

For the operational phase of the project, adverse amenity impacts are considered unlikely and compliance with applicable criteria is expected to be achieved during all periods and under worst-case meteorological conditions.

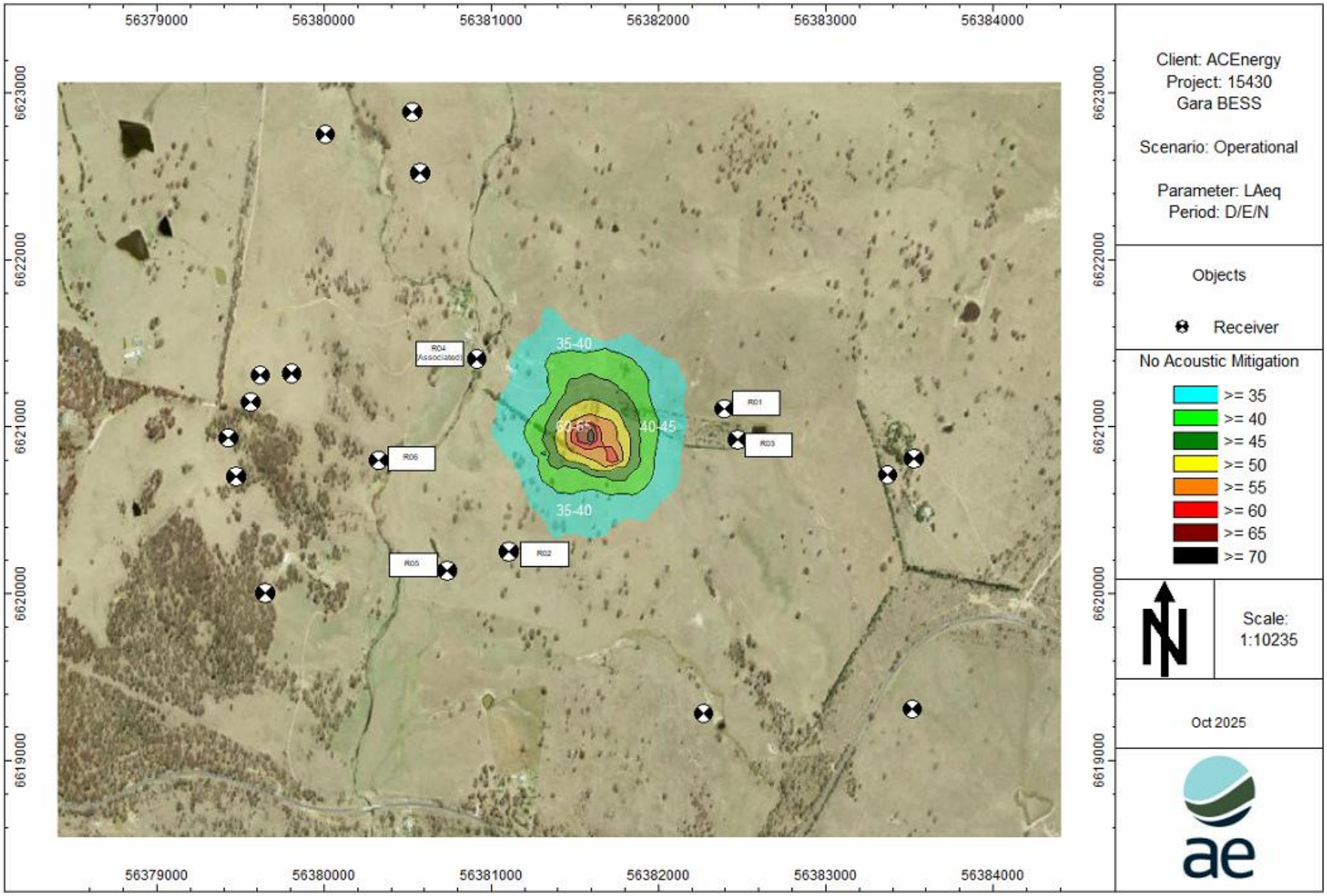
The cumulative operational impact of the nearby proposed developments is predicted to be negligible due to the large distance between most developments A cumulative operational assessment was undertaken using completed noise impact assessments with common sensitive receptors where applicable, the results of the cumulative assessment demonstrated the emissions caused by the Gara BESS were negligible (resulting in an increase <1dB) in comparison to noise emissions produced at other developments. Adverse amenity impacts are considered unlikely and compliance with applicable criteria is expected to be achieved.

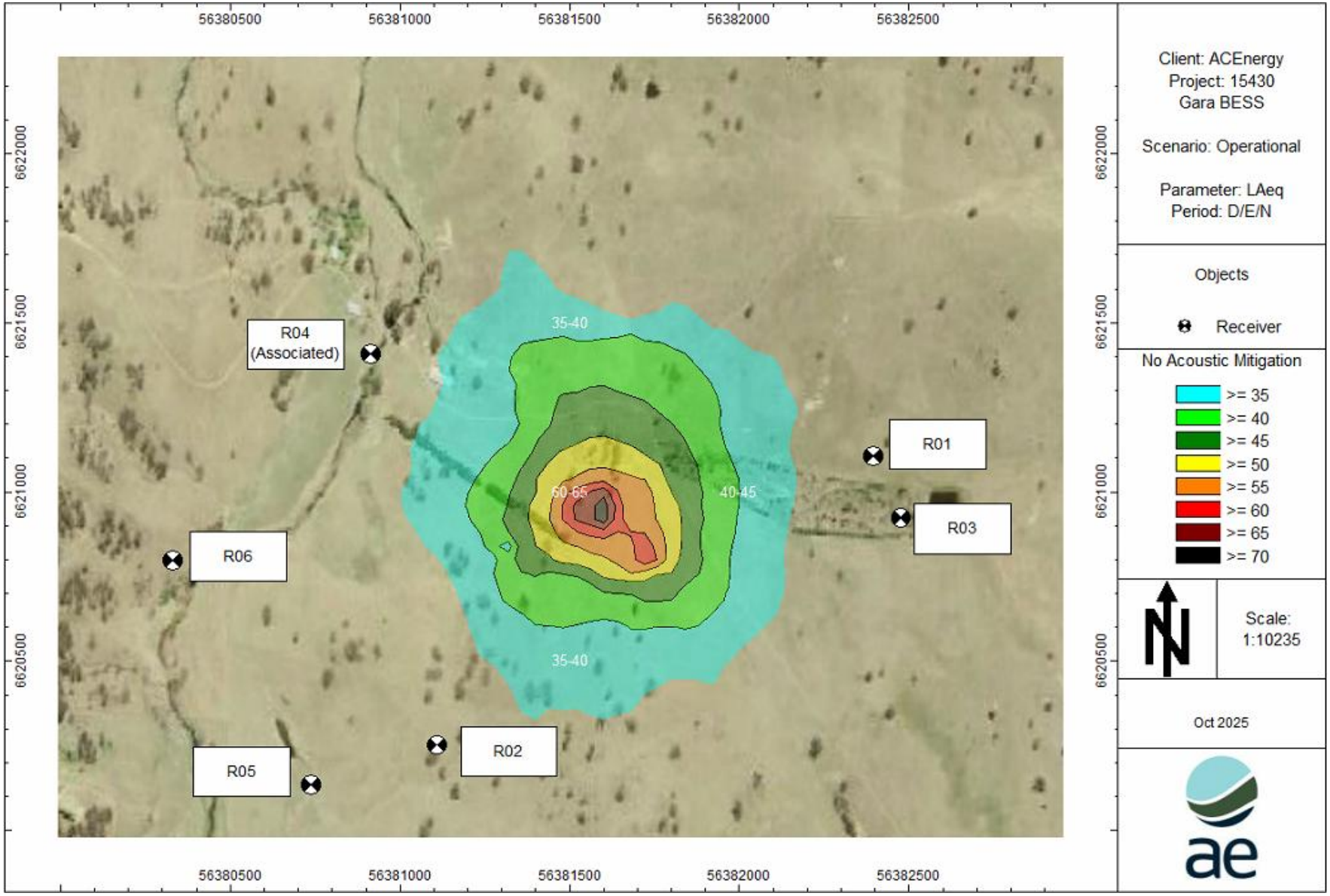
Overall, based on the results of the assessment, the risk of residual adverse impacts as a result of the proposed BESS is considered to be low with noise and vibration emissions complying with the applicable criteria. Hence, from an acoustic perspective, the proposed Subject Site is considered acceptable for the proposed use.

APPENDIX A: PROPOSED PLANS/ SITE LAYOUT



APPENDIX B: PREDICTIVE NOISE CONTOURS

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56382500
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6621500
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6620500
R04
(Associated)
R01
R03
R06
R05
R02
35-40
60-65
40-45
35-40
Client: ACEnergy
Project: 15430
Gara BESS
Scenario: Operational
Parameter: LAeq
Period: D/E/N
Objects
Receiver
No Acoustic Mitigation
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>= 50
>= 55
>= 60
>= 65
>= 70
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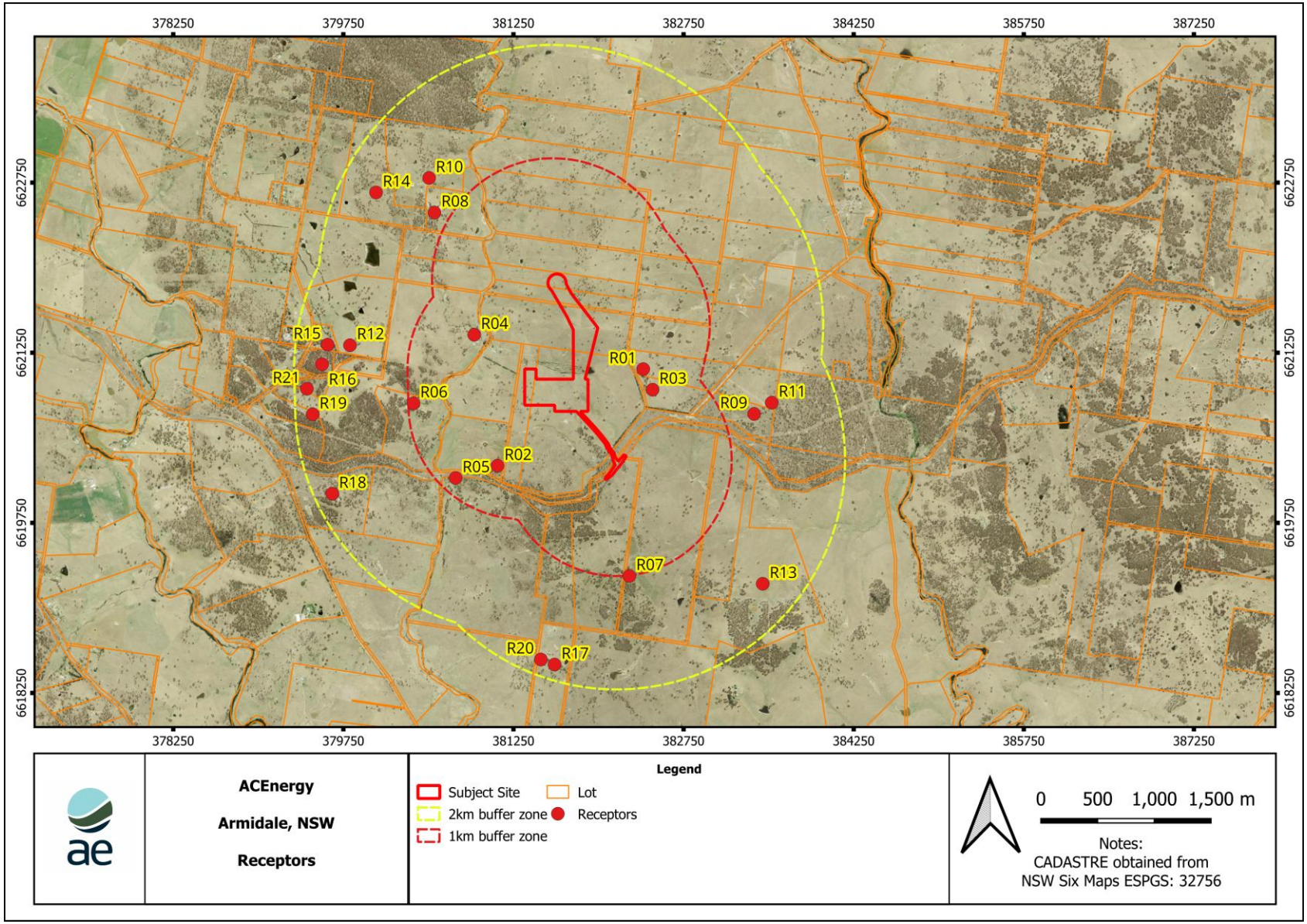
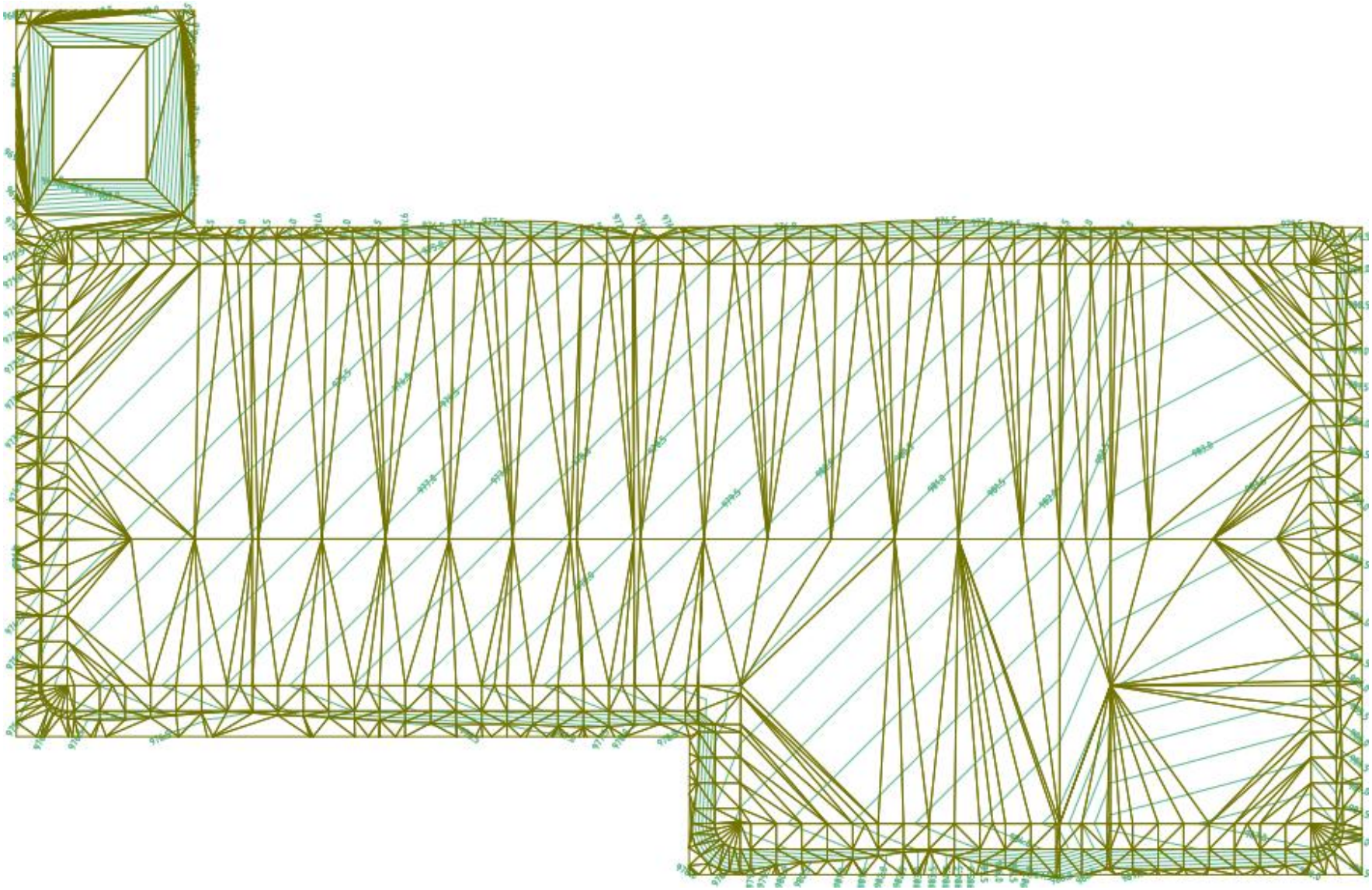
Scale:
1:10235
Oct 2025

APPENDIX C: RECEPTOR MAP



APPENDIX D: LOCAL SITE SPECIFIC TOPOGRPAHY



APPENDIX E: OXLEY SOLAR FARM RECEPTORS

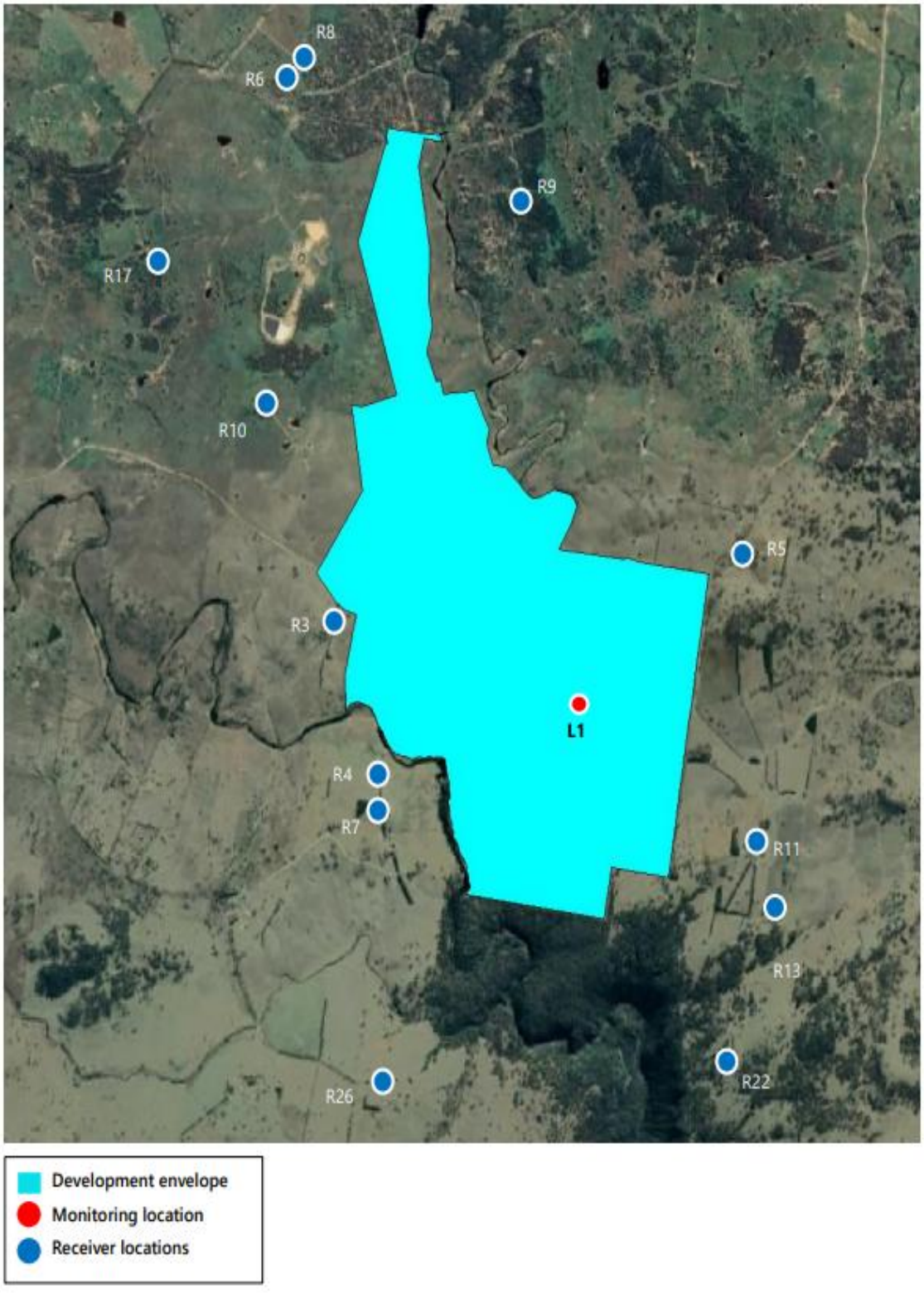


Figure 5: Oxley Solar Farm - Noise Impact Assessment Receptors

Table 5.5 – Predicted $L_{Aeq,15min}$ Operational Noise Levels at Residential Receiver Locations, dB(A)

Receiver Location	Project Noise Trigger Levels			Predicted Operational Noise Levels			Comply? (Yes/No)
	Day	Evening	Night	Calm & Isothermal Conditions	Slight to Gentle Breeze	Moderate Temperature Inversion[1]	
Receiver R3	*40*	*35*	*35*	24	31	30	Yes
Receiver R4	*40*	*35*	*35*	23	29	28	Yes
Receiver R5	*40*	*35*	*35*	23	29	28	Yes
Receiver R6	*40*	*35*	*35*	<20	<20	<20	Yes
Receiver R7	*40*	*35*	*35*	21	28	27	Yes
Receiver R8	*40*	*35*	*35*	<20	<20	<20	Yes
Receiver R9	*40*	*35*	*35*	20	27	26	Yes
Receiver R10	*40*	*35*	*35*	22	29	28	Yes
Receiver R11	*40*	*35*	*35*	21	28	26	Yes
Receiver R13	*40*	*35*	*35*	<20	26	25	Yes
Receiver R17	*40*	*35*	*35*	<20	20	21	Yes
Receiver R22	*40*	*35*	*35*	<20	20	<20	Yes
Receiver R26	*40*	*35*	*35*	<20	<20	<20	Yes

Notes: 1. Applicable for the night time period only

Table 4.4 – Predicted $L_{Aeq,15min}$ Construction Noise Levels at Receiver Locations, dB(A)

Plant Item	Plant Description	Predicted $L_{eq(15min)}$ Construction Noise Levels												
		R3	R4	R5	R6	R7	R8	R9	R10	R11	R13	R17	R22	R26
Noise Management Level[1]		*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
1	Small pile driving rig	<20-**55**	<20-45	<20-39	<20-42	<20-40	<20-41	<20-40	<20-34	<20-41	<20-29	<20-34	<20-29	<20-45
2	Crane	<20-**51**	<20-41	<20-35	<20-38	<20-36	<20-37	<20-36	<20-30	<20-37	<20-25	<20-30	<20-25	<20-41
3	Drum roller	<20-**50**	<20-40	<20-34	<20-37	<20-35	<20-36	<20-35	<20-29	<20-36	<20-24	<20-29	<20-24	<20-40
4	Padfoot roller	<20-**50**	<20-40	<20-34	<20-37	<20-35	<20-36	<20-35	<20-29	<20-36	<20-24	<20-29	<20-24	<20-40
5	Wheeled loader	<20-**50**	<20-40	<20-34	<20-37	<20-35	<20-36	<20-35	<20-29	<20-36	<20-24	<20-29	<20-24	<20-40
6	Dump truck	<20-**49**	<20-39	<20-33	<20-36	<20-34	<20-35	<20-34	<20-28	<20-35	<20-23	<20-28	<20-23	<20-39
7	30t Excavator	<20-**48**	<20-38	<20-32	<20-35	<20-33	<20-34	<20-33	<20-27	<20-34	<20-22	<20-27	<20-22	<20-38
8	Grader	<20-**48**	<20-38	<20-32	<20-35	<20-33	<20-34	<20-33	<20-27	<20-34	<20-22	<20-27	<20-22	<20-38
9	Chain trencher	<20-45	<20-35	<20-29	<20-32	<20-30	<20-31	<20-30	<20-24	<20-31	<20-19	<20-24	<20-19	<20-35
10	Water truck	<20-45	<20-35	<20-29	<20-32	<20-30	<20-31	<20-30	<20-24	<20-31	<20-19	<20-24	<20-19	<20-35
11	Telehandler	<20-39	<20-29	<20-23	<20-26	<20-24	<20-25	<20-24	<20-18	<20-25	<20-13	<20-18	<20-13	<20-29
12	Forklift	<20-31	<20-21	<20-15	<20-18	<20-16	<20-17	<20-16	<20-10	<20-17	<20-5	<20-10	<20-5	<20-21
Up to 3 (noisiest) plant operating concurrently		<20-**57**	<20-**47**	<20-**48**	<20-41	<20-45	<20-42	<20-44	<20-43	<20-36	<20-43	<20-31	<20-36	<20-32

Notes: 1. Bold font represents exceedance of the NML

Figure 2: Assessed Noise Sensitive Receivers

Site: Stringybark Solar Farm

Reference: 19SYA0044 R01_3

APPENDIX F: OLIVE GROVE SOLAR FARM RECEPTORS