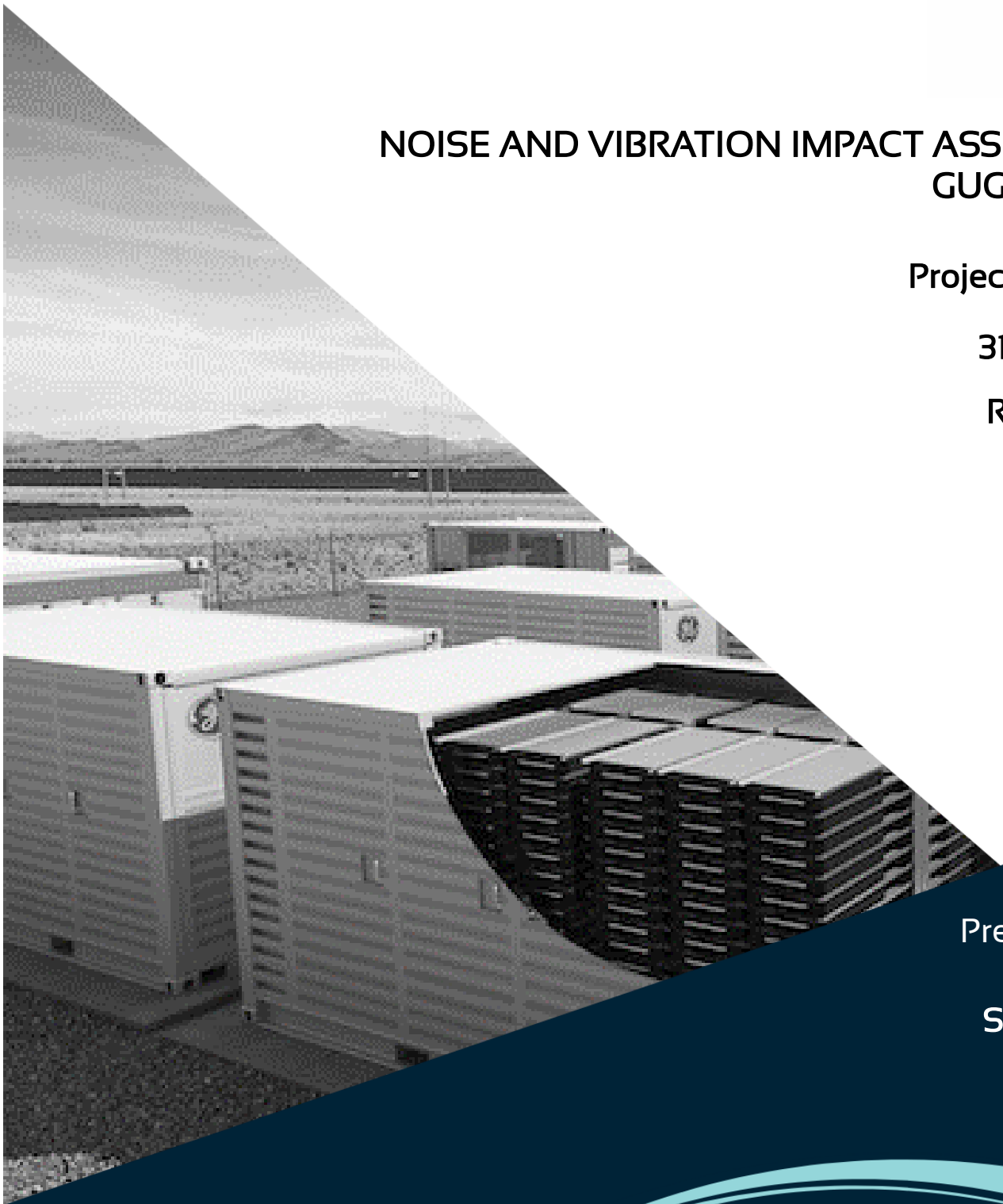

NOISE AND VIBRATION IMPACT ASSESMENT: GUGAA BESS

Project ID: 17103

31/10/2025

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Silo Energy

Assured Environmental

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Project Title: NOISE AND VIBRATION IMPACT ASSESMENT: GUGAA BESS

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Table 1: History of Revisions

Revision	Date	Issued to	Changes
R0	29/09/2025	S. Fuhrmann	Initial Release
R1	31/10/2025	A. Wilson	Final for Scoping

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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.
ABL	Assessment Background Level is derived from the measured noise levels and calculated to be the tenth percentile of the background L_{A90} noise levels (i.e. sort the recorded hourly L_{A90} into ascending order and select the lowest ten percentile level). The ABL is a single-figure background level representing each assessment period (day / evening / night).
Background Noise	Noise level at a given location and time measured in the absence of any alleged noise nuisance sources. Typically, represented by the L_{A90} noise statistic.
Calibrator	An instrument used to carry out 'field calibrations' before and after monitoring to ensure the sound level meter does not drift.
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/m2).
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.
Fast Time Weighting	Sound level meters apply a time-smoothing function to the measured sound. Fast time weighting has an exponential smoothing time constant of 125 milliseconds.
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.
PPV	Peak Particle Velocity is a term to measure ground vibration and refers to the movement within the ground of molecular particles rather than surface movement. It is commonly measured with units mm/s or mm/s-1.
RBL	Rating background noise level is the overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period.
SPL	Sound pressure level is a measure of the loudness of sound, determined by the pressure of sound waves in the air, measured in decibels (dB).
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 picowatt.

ABBREVIATIONS

AGL	Above Ground Level
BESS	Battery Energy Storage System
DEC	Department of Environment and Conservation (NSW)
DECC	Department of Environment and Climate Change (NSW)
DECCW	Department of Environment, Climate Change and Water (NSW)
DT	Department of Transportation (US)
EIS	Environmental Impact Statement
EPA	Environmental Protection Authority (NSW)
FTA	Federal Transit Administration (US)
ICNG	Interim Construction Noise Guideline
LGA	Local Government Area
LIDAR	Light Direction and Ranging
NEM	National Electricity Market
NPfI	Noise Policy for Industry
NSW	New South Wales
NVIA	Noise and Vibration Impact Assessment
PPV	Peak Particle Velocity
RMS	Root Mean Square
SSD	State Significant Development
US	United States
VDV	Vibration Dose Value

1 INTRODUCTION

1.1 Background

Silo Energy is seeking development consent to construct, operate and maintain a Battery Energy Storage System (BESS) on part of 477 Gregadoo East Road, Gregadoo, New South Wales (NSW). The proposed BESS would have a capacity of 1 GW and provide storage capacity to the National Electricity Market (NEM), increasing the stability of the electricity network by providing both energy and ancillary services.

1.2 Scope of Assessment

Assured Environmental (AE) was appointed by Silo Energy to undertake a Noise and Vibration Impact Assessment (NVIA) for the proposed BESS facility (herein referred to as 'the Subject Site).

This NVIA has been undertaken to assess the potential impacts of the construction and operation of the Subject Site, on nearby sensitive receptors in accordance with the following NSW policies and guidelines:

- Interim Construction Noise Guideline (ICNG) 2009;
- Assessing Vibration: A Technical Guideline 2006; and
- Noise Policy for Industry (NPfI) 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 Subject Site.

1.3 This Report

This report summarises the methodology, results and conclusions of the NVIA.

2 THE PROJECT

2.1 Overview

The proposed development comprises of a BESS facility that would store electricity from the grid and release electricity during periods of high demand. Key features of the establishment and operation of the Subject Site would include but not be limited to:

- Construction and operation of a BESS with a 1 GW maximum power output capacity and a four-hour duration;
- Connection of the BESS to the Gugaa Substation (currently under construction); and
- Other ancillary infrastructure and services required such as internal access roads, laydown areas, control, and operational buildings.

Further details relevant to this noise and vibration assessment are discussed in the following sub-sections.

2.2 Construction

The construction of the Subject Site is expected to take up to 12 months and will require various activities across the construction period. At this stage of development, specific timeframes for each construction activity are not yet established.

The key construction phases identified for construction of the Subject Site are;

- Enabling works;
- Civil, structural mechanical and electrical works;
- Testing and commissioning; and
- Demobilisation.

Construction would be restricted to 'recommended standard hours for construction work', as per the ICNG and described in Table 2.

Table 2: Standard Construction Hours

Work type	Weekday	Saturday	Sunday or Public Holiday
Normal Construction	7 am to 6 pm	8 am to 1 pm	No work

Minor construction activities such as electrical commissioning and fit out may occur outside of standard hours if required, and these works are expected to produce a negligible amount of noise.

The assessment will also consider vehicle movements involved with the construction of the Subject Site.

2.2.1 Equipment and Usage

Construction works are expected to progress across the site such that plant and equipment would only be in a single area for a short period of time. Given this, the potential for adverse impacts at any one receptor is expected to only occur for a short period of time.

A summary of the plant and equipment likely to be required to complete the on-site construction works is presented in Table 3. The Sound Power Level (SWL) of each plant item has been sourced from published noise emission datasets and the library of source noise levels maintained by AE.

Table 3: Construction Noise Sources

Construction Phase [a]	Timeframe	Plant Item	Number Required	Sound Power Level (SWL) (dB(A))	Acoustical Usage Factor (%) [b]
Site Establishment	Phase 1	Front end Loader	1	112	40
		Dump Truck	4	116	40
		Excavator	1	110	40
		Grader	1	113	40
		Compactor	1	106	20
		Diesel Generator	1	103	50
		Water cart	1	107	40
Civil Works for BESS	Phase 2	Front end loader	1	112	40
		Bobcat	4	106	40
		Concrete Truck	3	114	40
		Concrete pump	1	109	20
		Diesel Generator	1	103	50
		Concrete Saw	1	118	20
		Dump truck	2	113	40
Installation of BESS Equipment	Phase 3	Elevated work platforms	2	108	16
		Mobile Crane	1	107	16
		Hand Tools	5	102	50
		Diesel Generator	1	103	50
Installation of Ancillary Operational Equipment	Phase 4	Elevated work platform	1	102	98
		Hand Tools	5	102	99
		Mobile Crane	1	110	102
		Diesel Generator	1	103	100
Landscaping and establishment of noise walls	Phase 5	Water Truck	1	107	40
		Backhoe	1	110	40
		Compactor	1	106	20
		Fanna crane	1	98	16
		Bobcat	2	103	40
		Dump Truck	2	113	40
		Front end Loader	1	112	40
Decommissioning (inc. remediation)	Phase 6	Franna crane	2	101	16
		Trucks	3	113	40
		Excavator	1	110	40
		Bulldozer	1	109	40

a) Based on conservative estimates of equipment used in construction phases.
b) The 'Acoustical 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.

2.2.2 Road Volumes

A review of the preliminary Traffic Impact Assessment[a] does not indicate existing volumes along the surrounding roads, nor expected traffic generation as a result of the Subject Site's construction, operation, and decommissioning. Accordingly, there is insufficient information for an accurate assessment of on-road vehicle noise to be completed at this stage. Such an assessment will be completed during the preparation of the Environmental Impact Statement (EIS), and there is no further discussion of it within this report.

2.2.3 Potential Vibration Sources

Plant and equipment associated with construction of the Subject Site has the potential for vibration impacts. The vibration source levels for the equipment likely to be used for the construction of the Subject Site are detailed in Table 4 (vibration level is expressed as peak particle velocity (PPV)).

Table 4: Vibration Source levels – Peak Particle Velocity (PPV)

Equipment Item	PPV at 10 metres (mm/s)	Data Source
Roller	5 – 6	RTA [a)]
7 tonne compactors	5 – 7	RTA [a)]
Loaded trucks (rough surface)	5	US DT FTA [b)]
Loaded trucks (smooth surface)	1 – 2	US DT FTA [b)]
Excavator	2.5 – 4	RTA [a)]

a) Roads and Traffic Authority (RTA) Environmental Noise Management Manual; December, 2001.
b) United States (US) Department of Transportation (DT) Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment; September, 2018 – data converted from inches/second.

2.3 Operation

The Subject Site entails 1024 BESS units (eight blocks of 128 units) with a total 1 GW maximum power output capacity and a four-hour duration. A total of 256 step-up transformers will be located amongst the BESS units. Four 300 MVA grid transformers will also be located on-site.

It is assumed that the equipment will operate at 100% capacity. The layout of the proposed Subject Site is detailed in Figure 1.

2.3.1 Noise Sources

Noise emissions generated from BESS developments are primarily generated from the internal cooling mechanisms (namely fans or liquid chillers) which are required to prevent overheating and internal failure. Battery cells generate significant heat when charging or discharging making cooling systems vital in regulating internal temperatures.

[a] *Preliminary Traffic Assessment*, prepared by Amber, Reference 1337 rep 251023 final, dated October 2025

The other main source of noise emissions generated from BESS developments are from the transformers required to adjust voltage levels between the energy storage system and the power grid.

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. The sound power levels have been taken from the following sources:

- The BESS noise spectrum data has been sourced from equipment spectrums provided by the client, based on manufacturer datasheets for a currently available BESS system; and
- Noise source data for the step-up transformer, and BESS transformer have been obtained from the AE databases.

Table 5: Operational Noise Sources

Noise Source	Qty	Height (m)	Usage Period			SWL (L_{Aeq} dB(A))
			Day	Evening	Night	
BESS [a)]	1024	2.90	100%	100%	1000%	85.3
Inverters	256	1.5	100%	100%	100%	87.0
300 MVA transformers	256	2.0	100%	100%	100%	83.6

a) The sound power levels are based currently available BESS equipment. However, AE recognises that there is the potential for technology to change between the design and construction of this project such that nominating a single make/model is restrictive. As such, the presented sound power levels serve as suggested equipment sound power levels to guide the selection of appropriate equipment. AE recommends that final selections be confirmed to be appropriate through consultation with an acoustic specialist.

All noise sources associated with the BESS equipment 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 SWL, L_{Aeq} column. Source locations are shown in Figure 2.

The noise source data are based on the following information:

- Transformer SWL calculated from Australian / New Zealand Standard AS/NZS 60076.10: 2016 *Power transformers - Determination of sound levels* (AS/NZS 60076.10);
- 1/3 octave spectral data for transformers were taken from the Australian Acoustical Society[b];
- BESS noise data taken from manufacturer datasheets for typical equipment currently available on the market;

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

- Inverter noise data taken from AE's database;
- 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; and
- It should be noted that the L_{Amax} level associated with the cooling fans is taken into consideration in the energetic average (L_{Aeq}) noise level to reflect slight changes in the fan power. Therefore, a separate maximum noise assessment will not be undertaken.

Vehicle movements associated with the operational phase of the Subject Site would be limited to weekly operational maintenance conducted by a few staff members. As such, noise impacts are expected to be negligible and are not required to be assessed.

2.3.2 Noise Mitigation

The initial assessment of the development identified the need for noise mitigation measures. The location of these is indicated in Figure 2, with further details discussed in Section 6.3.4.

2.3.3 Potential Vibration Sources

Vibration impacts associated with the operational phase of the Subject Site are expected to be minimal due to the negligible vibration generated from the on-site equipment and the hardstand the equipment will be placed on. Operational vibration impacts have therefore not been assessed.

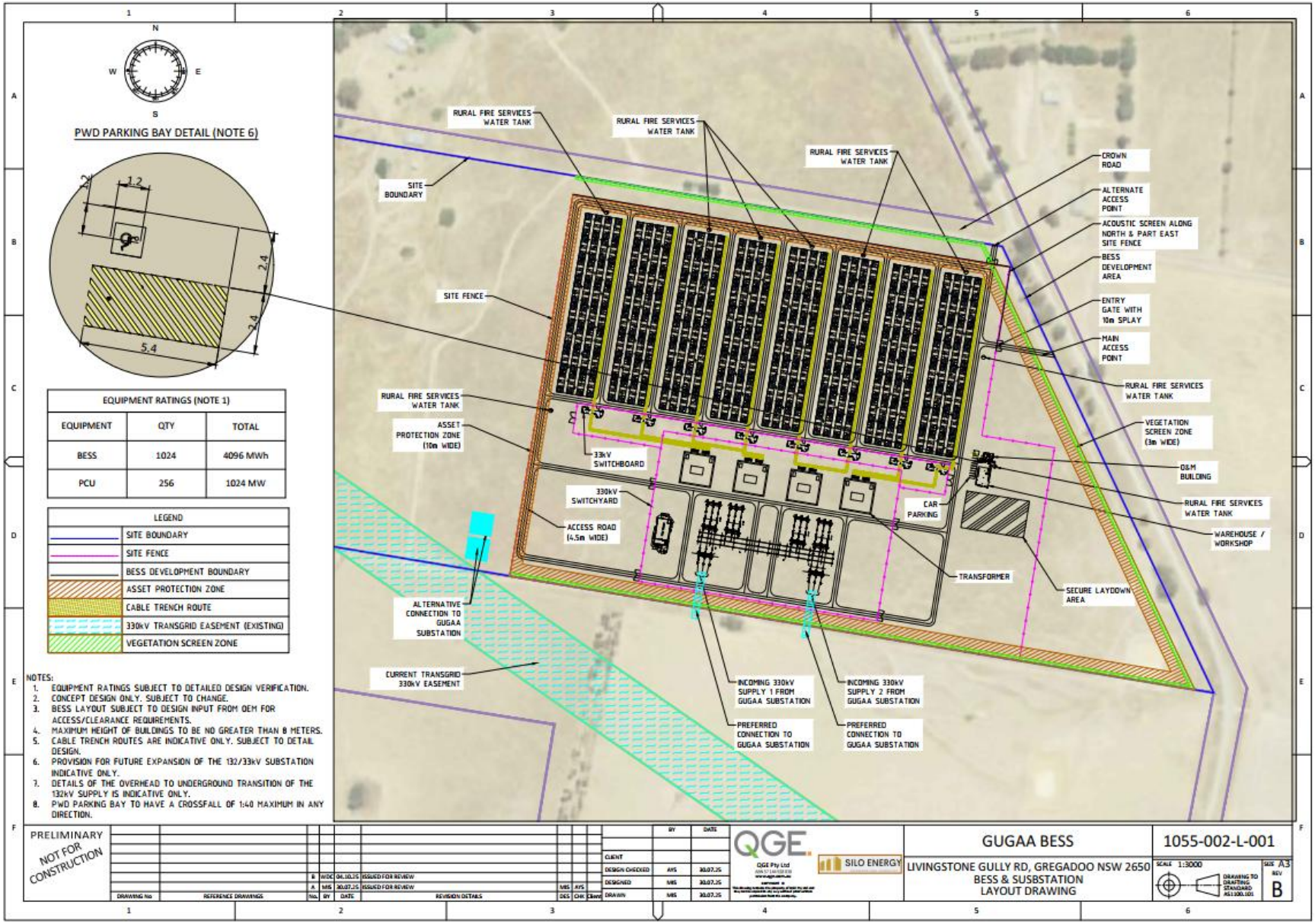


Figure 1: Layout of the Subject Site

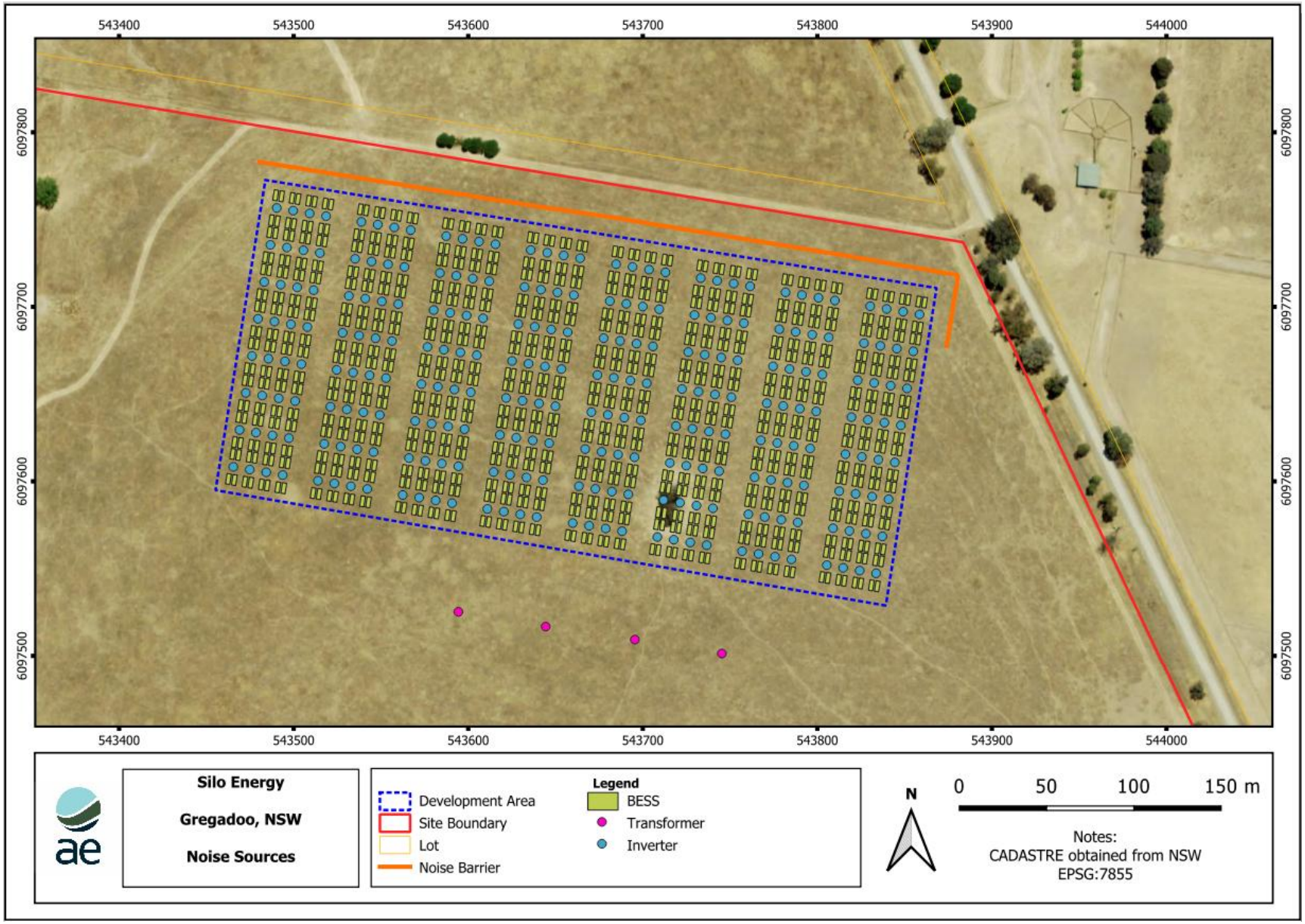


Figure 2: Noise Source and Barrier Locations

3 DESCRIPTION OF ENVIRONMENTAL VALUE

3.1 Project Location and Surrounding Land Use

The Subject Site is located on a portion of 477 Gregadoo East Road, Gregadoo NSW, formally identified as Lot 114 on DP757261. The Subject Site is located approximately 18 kilometres (km) south-east of Wagga Wagga and falls within the Wagga Wagga Local Government Area (LGA).

The entire lot of 477 Gregadoo East Road is approximately 40 hectares (ha) in total and the area that is likely to be physically disturbed by the Subject Site is approximately 20 ha. The Subject Site is zoned RU1: Primary Production and is situated in a rural area. It is mostly surrounded by further rural zoning.

The location of the Subject Site and surrounding land uses is shown in Figure 3.

3.2 Topography

The local topography, as obtained from NSW Six Maps, is illustrated in Figure 4. It can be seen in Figure 4 that the topography of the general area is flat. Site-specific topography (cut and fill to establish pads) is based on the Civil Drawings prepared by Northrop and distributed to AE on 12/09/2021.

3.3 Sensitive Receptors

There are existing dwellings located in the vicinity of the proposed BESS. Sensitive uses have been determined based on the land zoning and aerial imaging. The nearest sensitive receptors are shown in Figure 3 and listed in Table 6.

Table 6: Nearby Sensitive Receptors

Receptor ID	Description	Coordinates (EPSG:7855)		Distance to BESS (m) [a]	Assessable Height (m) [b]
		Easting	Northing		
R01	Rural residence – associated dwelling	543343	6097956	231	1.5 m
R02	Rural residence	543863	6098044	328	1.5 m
R03	Rural residence	543240	6098824	1080	1.5 m
R04	Rural residence	543931	6098928	1212	1.5 m
R05	Rural residence	544104	6098998	1308	1.5 m
R06	Rural residence	542528	6099201	1720	1.5 m
R07	Rural residence	543650	6095978	1563	1.5 m
R08	Rural residence	544474	6095922	1729	1.5 m
R09	Rural residence	541468	6098293	2083	1.5 m
R10	Rural residence	542683	6099724	2110	1.5 m
R11	Rural residence	545946	6097844	2083	1.5 m
R12	Rural residence	540902	6097902	2572	1.5 m
R13	Rural residence	544007	6099799	2084	1.5 m
R14	Rural residence	542026	6099934	2608	1.5 m
R15	Rural residence	546066	6098562	2358	1.5 m
R16	Rural residence	544125	6100161	2460	1.5 m

Receptor ID	Description	Coordinates (EPSG:7855)		Distance to BESS (m) [a]	Assessable Height (m) [b]
		Easting	Northing		
R17	Rural residence	541021	6099830	3210	1.5 m
R18	Rural residence	540583	6095955	3309	1.5 m
R19	Rural residence	545887	6099955	3019	1.5 m
R20	Rural residence	540317	6095965	3538	1.5 m
R21	Rural residence	546796	6098988	3196	1.5 m
R22	Rural residence	540488	6099870	3659	1.5 m
R23	Rural residence	540943	6095005	3610	1.5 m
R24	Rural residence	543881	6101050	3302	1.5 m
R25	Rural residence	546485	6099808	3355	1.5 m
R26	Rural residence	544077	6101091	3372	1.5 m
R27	Rural residence	547290	6098351	3483	1.5 m
R28	Rural residence	544522	6101054	3407	1.5 m
R29	Rural residence	539753	6096111	3990	1.5 m
R30	Rural residence	547522	6096929	3733	1.5 m
R31	Rural residence	542135	6094085	3752	1.5 m
R32	Rural residence	539647	6099005	4031	1.5 m
R33	Rural residence	540813	6100746	3998	1.5 m
R34	Rural residence	542945	6093868	3762	1.5 m
R35	Rural residence	539380	6096559	4207	1.5 m
R36	Rural residence	547330	6095500	4040	1.5 m
R37	Rural residence	540394	6094597	4287	1.5 m
R38	Rural residence	547175	6099789	3908	1.5 m
R39	Rural residence	546991	6100205	3998	1.5 m
R40	Rural residence	547786	6095819	4303	1.5 m
R41	Rural residence	544957	6101617	4056	1.5 m
R42	Rural residence	548085	6098045	4232	1.5 m
R43	Rural residence	545140	6101727	4214	1.5 m
R44	Rural residence	540234	6094153	4717	1.5 m
R45	Rural residence	542063	6093045	4760	1.5 m
R46	Rural residence	545437	6102077	4641	1.5 m
R47	Rural residence	539226	6100591	5108	1.5 m
R48	Rural residence	539513	6100971	5101	1.5 m
R49	Rural residence	547089	6093762	4978	1.5 m
R50	Rural residence	548864	6096512	5128	1.5 m
R51	Rural residence	540528	6102095	5238	1.5 m

a) Distance measured from boundary of the BESS footprint to sensitive receiver.
b) Per relevant criteria to be discussed in this assessment.

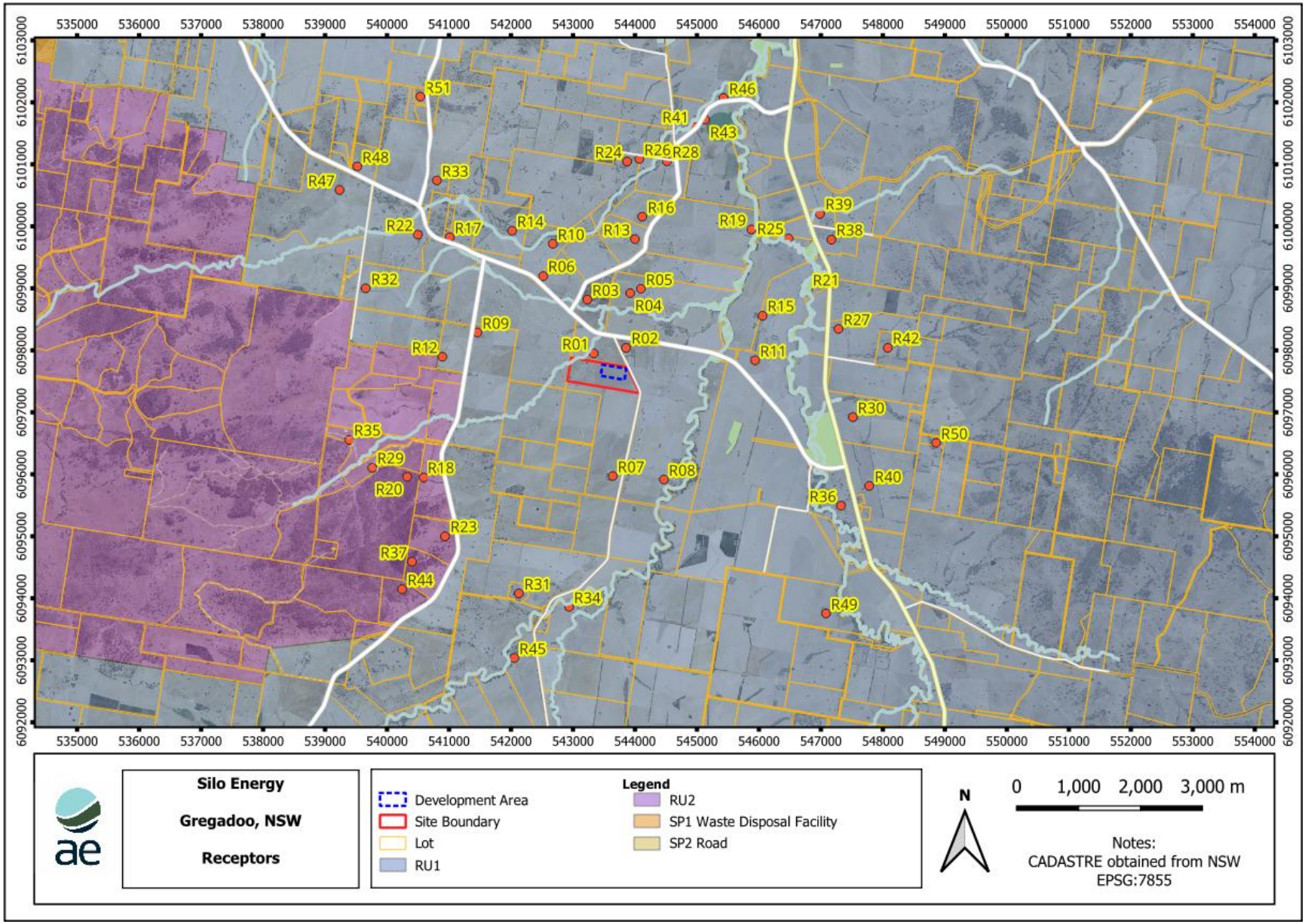


Figure 3: Surrounding Land Use & Sensitive Receptors

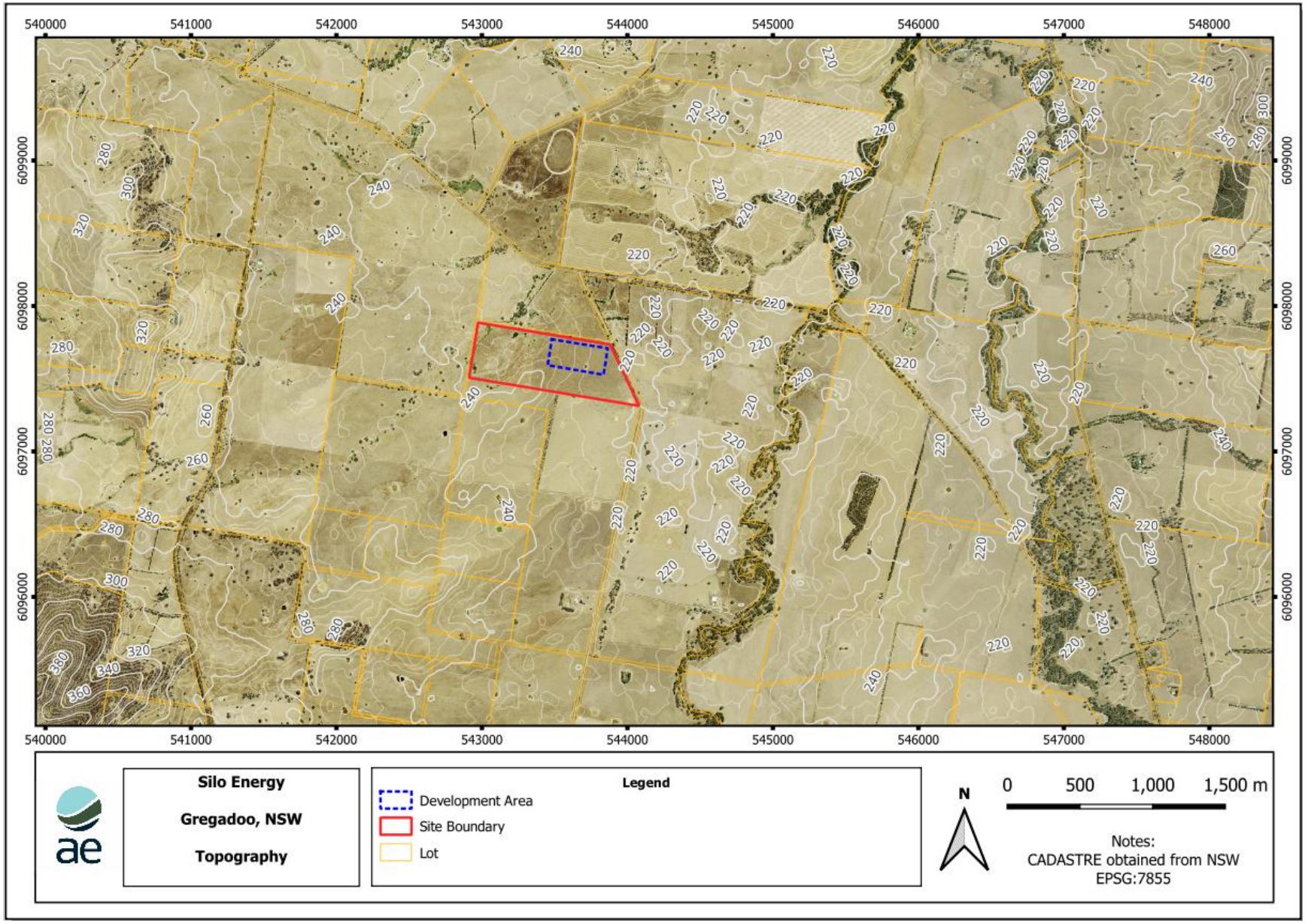


Figure 4: Topography

4 PROJECT CRITERIA

4.1 Overview

The assessment considers the potential impacts from noise and vibration during both the construction and operation of the Subject Site. As such, various criteria are applicable and are discussed in the following sections.

4.2 Construction Criteria

4.2.1 Construction Activities

Guidance on the assessment and management of construction noise in NSW is provided in the ICNG. The main objectives of the ICNG 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 (Table 1), 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; and
- provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

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 7 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 7: ICNG Relevant Construction Noise Criteria

Receptor Land Use	Time of Day	Management Level ($L_{Aeq,\ 15\text{-}minute}$)	How to Apply
Residential	Recommended standard hours: Monday to Friday, 7 am to 6 pm; Saturday 8 am to 1 pm; and	Noise affected. RBL [a] + 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.

	No work on Sundays or public holidays		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 [a)] + 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.
		Highly noise affected. 65 dB(A)	The proponent must justify the selection of feasible and reasonable mitigation, including the supplementary mitigation, with emphasis on consultation with the community and the consent authority or regulator and community views on work scheduling and respite periods.

a) RBL level from EPA minimum background levels.
b) Noise management noise levels only apply when the land use is being utilised, per ICNG.
c) "Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB. However, commercial buildings often have sealed windows and higher standards of noise mitigation than residential properties. Where a higher external to internal mitigation is assumed, this should be justified and supported by sufficient evidence." (Per ICNG).

As construction works for the Subject Site will occur within 'recommended standard hours', the criteria for 'outside recommended standard hours' will not be applicable to this assessment. The applicable receptor land uses to the Subject Site are residential.

The construction noise levels for residential land uses 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.

According to the ICNG, 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. Mitigation measures will be discussed, where required, as part of this assessment.

4.2.2 Construction Noise Criteria

The construction noise assessment criteria at sensitive receptors to the Subject Site have been determined using the Management Levels in Table 8, and where required, are based on the daytime RBL measured during background monitoring (representative of standard operating hours).

The construction noise criteria for the Subject Site are summarised in Table 8.

Table 8: Project Construction Noise Management Levels

Land Use	Time of Day	Criteria Type	Management Level ($L_{Aeq,\ 15\text{-minute}}$ dB(A))
Residential	Recommended Standard Hours (Daytime)	Noise Affected Criteria	35 + 10 = 45
		Highly Noise Affected Criteria	75

It is noted that consultation with potentially impacted residences and / or premises is required in accordance with ICNG.

4.2.3 Construction Vibration

4.2.3.1 Human Comfort

The vibration criteria presented in Assessing Vibration: A Technical Guideline have been adopted for the assessment. Assessing Vibration: A Technical Guideline provides vibration criteria associated with amenity impacts (human annoyance and comfort) for the three categories of vibration:

- Continuous vibration – continues uninterrupted for a defined period (e.g. road traffic, continuous construction activity);
- Impulsive vibration – includes less than 3 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.

Continuous and impulsive vibration sources are measured in terms of PPV, and intermittent vibration is measured in terms of vibration dose value (VDV). Table 9 presents the criteria for vibration, per Assessing Vibration: A Technical Guideline.

Table 9: Vibration Criteria for Various Receptors

Receptor Use	Vibration Type	Assessment Period	Preferred Limit	Maximum Limit
Critical Areas [a)]	Continuous (PPV)	Day or Night	0.14 mm/s	0.28 mm/s
	Impulsive (PPV)	Day or Night	0.14 mm/s	0.28 mm/s
	Intermittent (VDV)	Day or Night	0.1 $m/s^{1.75}$	0.2 $m/s^{1.75}$
Residences	Continuous (PPV)	Day	0.28 mm/s	0.56 mm/s
		Night	0.2 mm/s	0.4 mm/s
	Impulsive (PPV)	Day	8.6 mm/s	17. mm/s
		Night	2.8 mm/s	5.6 mm/s
	Intermittent (VDV)	Day	0.2 $m/s^{1.75}$	0.4 $m/s^{1.75}$
		Night	0.13 $m/s^{1.75}$	0.26 $m/s^{1.75}$
Offices	Continuous (PPV)	Day or Night	0.56 mm/s	1.1 mm/s
	Impulsive (PPV)	Day or Night	18 mm/s	36 mm/s
Offices, schools, educational and places of worship	Intermittent (VDV)	Day or Night	0.4 $m/s^{1.75}$	0.8 $m/s^{1.75}$
Workshop	Continuous (PPV)	Day or Night	1.1 mm/s	2.2 mm/s
	Impulsive (PPV)	Day or Night	18 mm/s	36 mm/s
	Intermittent (VDV)	Day or Night	0.8 $m/s^{1.75}$	1.6 $m/s^{1.75}$

a) E.g. hospital operating theatres and precision laboratories.

4.2.3.2 Structural Damage

To assess potential damage to buildings, reference has been made to British Standard BS 7385-2: 1993 *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration* (BS 7385-2).

Table 10 presents vibration criteria for assessing the potential for building damage (cosmetic damage), respective of PPV and frequency (Hz).

Table 10: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	PPV, mm/s	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 at 4 Hz and above	
Unreinforced or light-framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 at 15 Hz	20 at 15 Hz increasing to 50 at 40 Hz and above

Note: Applicable criteria are highlighted.

4.3 Operational Criteria

4.3.1 Overview

The noise 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 trigger levels' against which the proposed development will be assessed. The lower and most stringent of the two is used to determine the 'project trigger level' which, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response.

The NPfI also considers the potential for sleep disturbance from maximum noise level events from premises during the night-time period.

The derivation of NPfI criteria, relevant to the operation of the Subject Site is discussed in the sub-sections below.

The noise criteria are assessed at the reasonably most-affected point (i.e. highest noise level) on or within the property boundary. For residential dwellings, where the property boundary is more than 30 m from the house, then the criteria apply at the reasonably most-affected point within 30 m of the residence, but not closer than 3 m to a reflective surface and at a height of between 1.2 m – 1.5 m above the ground level.

4.3.2 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 RBL) by more than 5 dB(A).

For this project, background noise monitoring was deemed unnecessary given the rural location of the Subject Site and absence of surrounding roads or industry that would elevate the background noise, particularly during the critical night period. As such, AE has referenced the EPA minimum RBLs per the NPfI.

The derived Project Intrusiveness Noise Levels are detailed in Table 11.

Table 11: Derived Project Intrusiveness Noise Levels

Location	Period	RBL, dB(A)	Intrusiveness Noise Level, $L_{Aeq,15minute}$ dB(A)
Nearby residential receptors	Day (7 am to 6 pm)	35	RBL + 5 = 40
	Evening (6 pm to 10 pm)	30	RBL + 5 = 35
	Night (10 pm to 7 am)	30	RBL + 5 = 35

4.3.3 Amenity Criteria

The Project Amenity Noise Level seeks to protect against cumulative noise impacts from industry and maintain amenity for land uses. Amenity noise levels are not used directly as regulatory limits. They are used in combination with the intrusiveness noise level to assess the potential impact of noise, assess reasonable and feasible mitigation options, and subsequently determine achievable noise requirements.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a Project Amenity Noise Level applies for each new source of industrial noise and is calculated as the Recommended Amenity Noise Level (per the receiver category in the NPfI) minus 5 dB(A). Additionally, a correction of +3 dB(A) is used to convert from $L_{Aeq,period}$ to a $L_{Aeq,15\text{-}minute}$ metric.

Receiver categories relevant to this assessment are Industrial premises, Suburban residential and Rural residential. This is based on the LGA zoning (nearby receptor categories are described in Table 6), however the receiver categories set out in the NPfI are typically in-line the measured background noise levels.

The Recommended Amenity Noise Levels are detailed in Table 12. The derived Project Amenity Noise Levels, relevant to the Project (i.e. industrial, suburban residential and rural residential) are also detailed in Table 12.

Table 12: Project Amenity Noise Levels

Receptor Type	Period	Recommended Amenity Noise Level, $L_{Aeq,period}$ dB(A)	Project Amenity Noise Level [a], $L_{Aeq,15\text{-}minute}$ dB(A)
Rural residential	Day (7 am to 6 pm)	50	50 – 5 + 3 = 48
	Evening (6 pm to 10 pm)	45	45 – 5 + 3 = 43
	Night (10 pm to 7 am)	40	40 – 5 + 3 = 38
Suburban residential	Day (7 am to 6 pm)	55	-
	Evening (6 pm to 10 pm)	45	-
	Night (10 pm to 7 am)	40	-
Urban	Day (7 am to 6 pm)	60	-
	Evening (6 pm to 10 pm)	50	-
	Night (10 pm to 7 am)	45	-
Hotels, motels, caravan parks		5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area	-

Receptor Type	Period	Recommended Amenity Noise Level, $L_{Aeq,period}$ dB(A)	Project Amenity Noise Level [a], $L_{Aeq,15\text{-}minute}$ dB(A)
School classroom - internal	Noisiest 1 hour, when in use	35	-
Hospital ward:			
internal	Noisiest 1 hour	35	-
external	Noisiest 1 hour	50	-
Place of worship	When in use	40	-
Passive recreation	When in use	50	-
Active recreation	When in use	55	-
Commercial premises	When in use	65	-
Industrial	When in use	70	-
Industrial interface (applicable only to residential noise amenity areas)	All	Add 5 dB(A) to recommended noise amenity area	-

a) The project amenity noise level is set at 5 dB below the recommended amenity noise level and a correction of +3 dB used to convert to a $L_{Aeq,15\text{-}minute}$ metric.

4.3.4 Project Noise Trigger Levels

The Project Noise 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 $L_{Aeq,15\text{-}minute}$ dB(A) equivalent level (conversion included in Table 12 results). The applicable Project Noise Trigger Levels, determined from the lower of the Project Intrusiveness Noise Level and Project Amenity Noise Level are detailed in Table 13.

Table 13: Determining Project Noise Trigger Level

Receptor Type	Period	Standardised $L_{Aeq,15\text{-}minute}$ Noise Level, dB(A)		
		Intrusiveness Noise Level	Amenity Noise Level	Noise Trigger Level
Rural residential (all)	Day (7 am to 6 pm)	40	48	40
	Evening (6 pm to 10 pm)	35	43	35
	Night (10 pm to 7 am)	35	38	35

4.3.5 Sleep Disturbance

The NPfI identified a screening assessment for sleep disturbance based on the night-time noise levels at a residential location. The night-time screening level applicable to the Subject Site is detailed in Table 14.

Table 14: Sleep Disturbance Night-time Screening Level

Receptor Type	Night-time RBL (dB(A))	Greater of 40 or RBL+ 5 ($L_{Aeq,15\text{-}minute}$ dB(A))	Greater of 52 or RBL+ 15 (L_{Amax} dB(A))
Residential	30	40	52

It is noted that the $L_{Aeq,15\text{-}minute}$ 40 dB(A) sleep disturbance screening level is less stringent than the night-time Project Trigger Noise Level of $L_{Aeq,15\text{-}minute}$ 35 dB(A), thus compliance with the Project Trigger Noise Level will imply compliance with this sleep disturbance screening level.

4.3.6 Summary of Operational Criteria

The noise criteria (for each time period; day, evening and night) at sensitive receptors around the Subject Site have been determined using the criteria in Table 11, Table 12, Table 13 and Table 14.

For this assessment, the limiting operational criteria in Table 15 has been adopted and is listed according to the receptor type and ID (per Table 6).

Table 15: Limiting Operational Criteria

Receptor Type and ID	Period	Noise Parameter (dB(A))	
		$L_{Aeq,15\text{-}minute}$)	L_{Amax}
Rural residential (all)	Day (7 am to 6 pm)	40	-
	Evening (6 pm to 10 pm)	35	-
	Night (10 pm to 7 am)	35	52

5 ASSESSMENT METHODOLOGY

5.1 Construction Activities

For the purposes of predicting impacts associated with noise emissions from construction activities related to the Subject Site on nearby sensitive receptors, noise levels have been predicted using first-principle calculations. These calculations account for the distance between the receptor and the Subject Site infrastructure, as well as the noise level of each source.

Construction activities are expected to vary in both location and duration across the site, with mobile equipment moving throughout the construction phase. The construction noise levels at nearby sensitive receptors have been predicted taking into consideration the following assumptions:

- All plant and equipment are operating simultaneously at the nearest point of the Subject Site boundary to the receptors. This represents a hypothetical worst-case scenario and unlikely to occur in practice;
- The equipment quantities are currently estimates; and
- Noise propagation is assumed to occur over hard ground, with no screening objects between the source and the receptor.

5.2 Construction Vibration

Vibration impacts associated with the construction phase of the Subject Site have been assessed. In particular, the assessment has considered the potential for impacts on both human comfort and structural damage for the nearest residential receptors to the construction works.

Based on the vibration source levels (presented in Table 4), PPVs have been predicted at various separation distances. Assessing Vibration: A Technical Guideline indicates that in predicting vibration levels, it can be assumed that the vibration level is inversely proportional to distance.

The US DT FTA Transit Noise and Vibration Impact Assessment Manual (2018)[c] 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)

c US DT FTA (2018). Transit Noise and Vibration Impact Assessment Manual. Obtained from https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf on 17 January 2025.

The above formula has been considered for predicted PPVs at various distances from construction equipment.

5.3 Operations

5.3.1 Software

For the purposes of predicting impacts associated with operational noise emissions from the Subject Site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software CadnaA (Version 2024 MR2 build 203.5403) developed by DataKustik. CadnaA incorporates the influence of meteorology, terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations.

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.

5.3.2 Meteorology

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, 'standard conditions' and 'noise enhancing conditions'. The meteorological conditions shown in Table 16 were selected to predict the worst-case noise levels at all receptors during all seasons and time periods.

Table 16: Noise Enhancing Meteorological Conditions

Time Period	Meteorological Parameters [a)]		
	Stability Class [b)]	Wind Speed (m/s) [c)]	Wind Direction [d)]
Day (7 am to 6 pm)	D	3	Neutral
Evening (6 pm to 10 pm)	D	3	Neutral
Night (10 pm to 7 am)	F	2	Worst-case

a) Meteorological conditions based on 'noise enhancing conditions', per NPfI.
a) Pasquill Gifford Atmospheric Stability Class.
b) At 10 m, above ground level (AGL).
c) Wind direction source to receptor.

5.3.3 Model Configuration

Table 17 summarises the model configuration used for the modelling.

Table 17: Model Configuration

Parameter	Approach
Standards	CONCAWE
Time Periods	Day (7 am to 6 pm) Evening (6 pm to 10 pm) Night (10 pm to 7 am)
Digital Terrain	LIDAR data at 1 m intervals..
Ground Absorption	Ground absorption set for absorptive ground (1.0)

6 NOISE AND VIBRATION IMPACT ASSESSMENT RESULTS

6.1 Overview

This section presents the findings of the noise and vibration impact assessment for the Subject Site, including noise and vibration from construction activities, noise from construction-related traffic, and operational noise emissions.

6.2 Construction Phase

6.2.1 Construction Activities

The predicted construction noise levels from construction activities at nearby sensitive receptors to the Subject Site are presented in Table 18.

The results indicate that construction works may be above the Noise Affected criteria of 45 dB(A) but are expected to comply with the Highly Noise Affected criterion of 75 dB(A) at all times. No predictions for overlapping construction stages are made, as the exact details of any overlapping periods are not known at this stage. However, based on the predicted results it is evident that any two stages overlapping would not change the result to an extent that the Highly Noise Affected criterion would be exceeded.

The highest predicted noise level is 68 - 69 dB(A) at receptor R02 during 'site establishment' and 'civil works' phases. This predicted noise level is expected only to occur during initial construction phases.

It is recommended that reasonable and feasible mitigation measures such as those presented in Section 3.5 and 3.6 of this report are implemented to reduce the noise impact at all receptors.

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.

Table 18: Predicted Construction Noise Levels at Sensitive Receptors

Receptor	Standard Hours Criteria (dB(A))		Predicted Construction Noise Levels for each Construction Phase ($L_{Aeq, 15min}$ dB(A))					
	Noise Affected	Highly Noise Affected	Site Establishment	Civil Works	Installation of BESS Equipment	Installation of Ancillary Operational Equipment	Landscaping and establishment of noise walls	Decommissioning
R01 (Associated)	45	75	72	71	62	62	68	67
R02	45	75	69	68	59	59	65	64
R03	45	75	59	58	48	48	54	54
R04	45	75	58	57	47	47	53	53
R05	45	75	57	56	47	47	53	52
R06	45	75	55	54	44	44	50	50
R07	45	75	55	55	45	45	51	51
R08	45	75	55	54	44	44	50	50
R09	45	75	53	52	43	43	49	48
R10	45	75	53	52	42	42	48	48
R11	45	75	53	52	43	43	49	48
R12	45	75	51	50	41	41	47	46
R13	45	75	53	52	43	43	49	48
R14	45	75	51	50	41	41	47	46
R15	45	75	52	51	41	41	47	47
R16	45	75	52	51	41	41	47	47
R17	45	75	49	49	39	39	45	45
R18	45	75	49	48	39	39	44	44
R19	45	75	50	49	39	39	45	45
R20	45	75	48	48	38	38	44	44
R21	45	75	49	49	39	39	45	45

Receptor	Standard Hours Criteria (dB(A))		Predicted Construction Noise Levels for each Construction Phase ($L_{Aeq, 15min}$ dB(A))					
	Noise Affected	Highly Noise Affected	Site Establishment	Civil Works	Installation of BESS Equipment	Installation of Ancillary Operational Equipment	Landscaping and establishment of noise walls	Decommissioning
R22	45	75	48	47	38	38	44	43
R23	45	75	48	48	38	38	44	43
R24	45	75	49	48	39	39	45	44
R25	45	75	49	48	38	38	44	44
R26	45	75	49	48	38	38	44	44
R27	45	75	48	48	38	38	44	44
R28	45	75	49	48	38	38	44	44
R29	45	75	47	47	37	37	43	43
R30	45	75	48	47	37	37	43	43
R31	45	75	48	47	37	37	43	43
R32	45	75	47	47	37	37	43	43
R33	45	75	47	47	37	37	43	43
R34	45	75	48	47	37	37	43	43
R35	45	75	47	46	36	36	42	42
R36	45	75	47	47	37	37	43	43
R37	45	75	47	46	36	36	42	42
R38	45	75	47	47	37	37	43	43
R39	45	75	47	47	37	37	43	43
R40	45	75	47	46	36	36	42	42
R41	45	75	47	47	37	37	43	42
R42	45	75	47	46	36	36	42	42
R43	45	75	47	46	36	36	42	42
R44	45	75	46	45	35	35	41	41

Receptor	Standard Hours Criteria (dB(A))		Predicted Construction Noise Levels for each Construction Phase ($L_{Aeq, 15min}$ dB(A))					
	Noise Affected	Highly Noise Affected	Site Establishment	Civil Works	Installation of BESS Equipment	Installation of Ancillary Operational Equipment	Landscaping and establishment of noise walls	Decommissioning
R45	45	75	46	45	35	35	41	41
R46	45	75	46	45	36	36	42	41
R47	45	75	45	45	35	35	41	40
R48	45	75	45	45	35	35	41	40
R49	45	75	45	45	35	35	41	41
R50	45	75	45	44	35	35	41	40
R51	45	75	45	44	35	35	41	40

6.2.2 Mitigation of Construction Noise Levels

Given the variable and mobile nature of the construction works, 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;
- 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 project requirements for reference;
- Inform truck drivers 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;
- Using broad band reversing alarms on all mobile plant and equipment where possible;
- 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;
- Regularly inspect and maintain equipment to ensure it is in good working order including checking the condition of mufflers;
- Avoid unnecessary dropping of materials from a height and metal to metal contact on equipment; and
- 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.

It should be noted that the construction assessment is conservative in nature and that the likelihood of exceeding these noise levels is low. As the 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.

6.2.3 Cumulative Construction Noise Impacts

A review of other noise generating developments in the surrounding area identifies the Livingstone Solar Farm (State Significant Development SSD-80114208), which is currently in the 'Prepare EIS' stage. It located at 731 Livingstone Gully Road, Big Springs, which is immediately to the south and east of the Subject Site.

As the EIS has not yet been prepared, there is no information available on the extent of any construction impacts from the Livingstone Solar Farm, nor its timeline for construction works.

AE notes that the above construction assessment of the Subject Site identified exceedances of the Noise Affected management level and provided recommendations for feasible and reasonable mitigation measures accordingly (per the assessment process within the ICNG). For cumulative construction impacts to trigger additional controls beyond those required for the the individual construction impacts from the Subject Site, the cumulative impacts would have to be above the Highly Noise Affected level of 75 dB(A).

Where two sources contribute to the overall noise level, and one source is 10 dB or more below the other, then it has a negligible impact compared to the louder source. As such, the only receptors to be reviewed for cumulative construction impacts are those that are less than 10 dB below the Highly Noise Affected level, i.e. more than 65 dB(A). The only receptors where this is true are R01 (the receptor associated with the Subject Site), and R02 (a receptor associated with the Livingstone Solar Farm). At all other receptors, the contribution from the Subject Site when considered cumulatively would not result construction noise levels that would trigger additional controls.

At R01 and R02, AE notes that the impacts of a project on an associated receptor are typically not considered, thus no consideration of cumulative impacts is warranted for either receptor. As a result, an acceptable outcome is reached for all receptors.

6.2.4 Vibration Impacts

The predicted vibration impacts during the construction of the Subject Site (expressed as PPV, mm/s), per the methodology discussed in Section 5.2, are presented in Table 19.

Table 19: Predicted PPV at Distances

Distance from Source (m)	Predicted PPV (mm/s)			
	7 Tonne Compactors	Excavator	Loaded Trucks (Rough Surfaces)	Loaded Trucks (Smooth Surfaces)
10	7.00	4.00	5.00	2.00
20	2.47	1.41	1.77	0.71
50	0.63	0.36	0.45	0.18
100	0.22	0.13	0.16	0.06
200	0.08	0.04	0.06	0.02
500	0.02	0.01	0.01	0.01
1000	0.01	0.00	0.01	0.00
Type	Continuous		Intermittent	
Nuisance Criteria	Residence 0.28 (preferred) / 0.56 (max)		Residence 0.2 $m/s^{1.75}$ (preferred) / 0.4 $m/s^{1.75}$ (max) a)	
Building Criteria	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			

Note: All results are PPV, mm/s. Criteria are mm/s unless otherwise indicated.
a) VDV, $m/s^{1.75}$.

The predicted vibration levels presented in Table 19 indicate compliance with the continuous maximum vibration criteria of 0.56 mm/s, for locations at a separation distance of beyond approximately 50 m. Compliance with the building damage criteria of 15 mm/s is predicted at 10 m from construction for each source. Therefore, as the closest non-associated receptor is 328 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 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 loaded trucks at distances of 328 m (the distance to the nearest Residential receptor) is predicted to be less than 0.03 mm/s which is well below the applicable criteria of 0.20 mm/s.

6.3 Operational Noise Levels

6.3.1 Period Assessment

The predicted receptor noise levels during the operational phase of the Subject Site are based on the SWLs listed in Table 5 and the source and barrier locations identified in Figure 2.

The predicted operational noise levels from the Subject Site at nearby sensitive receptors, per the methodology described in Section 5.3, are presented in Table 20.

A review of the 1/3 octave receptor levels reveals no tonality or low frequency noise, thus corrections for annoying characteristics are not warranted.

Table 20: Predicted Receptor Noise Levels

Receptor	Predicted Noise Levels (dB(A))			Criteria (d(A)) (Day / Eve / Night)	Comply (Y/N)
	Day ($L_{Aeq, 15min}$)	Evening ($L_{Aeq, 15min}$)	Night ($L_{Aeq, 15min}$)		
R01 - Associated	30	30	39	n/a	n/a
R02	25	25	35	40 / 35 / 35	Y / Y / Y
R03	<15	<15	23	40 / 35 / 35	Y / Y / Y
R04	< 15	< 15	22	40 / 35 / 35	Y / Y / Y
R05	< 15	< 15	21	40 / 35 / 35	Y / Y / Y
R06	< 15	< 15	17	40 / 35 / 35	Y / Y / Y
R07	< 15	< 15	23	40 / 35 / 35	Y / Y / Y
R08	< 15	< 15	21	40 / 35 / 35	Y / Y / Y
All other receptors	< 15	< 15	< 15	40 / 35 / 35	Y / Y / Y

A review of the predicted noise levels confirms that compliance with the assessment criteria established in accordance with the NPfI can be achieved for all receptors during the daytime, evening, and night-time periods under noise-enhancing meteorological conditions. These results are inclusive of all mitigation measures discussed in Section 6.3.4.

6.3.2 Maximum Assessment

BESS's operate with relatively stable noise emissions due to their steady-state nature, where the primary noise sources (cooling fans, inverters, and transformers) function at consistent loads for extended periods. Unlike intermittent or impulsive sources, such as industrial machinery or transport noise, a BESS typically produces a continuous broadband noise spectrum with minimal variation in sound power levels.

In the absence of manufacturer-provided maximum noise level data, it is reasonable to assume that the peak noise levels are only marginally higher than the typical operating levels. This is because fan speeds, which are the dominant variable noise source, are primarily driven by ambient temperature and thermal load rather than instantaneous power demand. While emergency conditions, such as thermal runaway mitigation, could theoretically induce short-term increases in noise, standard operating conditions result in relatively stable emissions.

Consequently, the difference between average and maximum noise levels is expected to be low (2 - 5 dB(A)). The L_{Amax} criterion is 52 dB(A), and the expected maximum noise level is no greater than 35 + 5 = 40 dB(A) at receptor R02, thus the BESS passes the screening assessment for sleep disturbance and no further consideration is warranted.

6.3.3 Noise Isopleths

Noise isopleths of the operational predicted operational noise levels from the Subject Site are presented in Appendix B.

6.3.4 Proposed Noise Mitigation

The predicted receptor noise levels detailed in Table 20, include noise mitigation measures. Noise mitigation in the form of acoustic barriers and restrictions on maximum sound power levels for equipment were applied to achieve compliance with the applicable operation noise criteria. The mitigation measures are discussed below.

6.3.4.1 Noise Barriers

A single noise barrier along the northern boundary and a portion of the northeast corner has been designed to mitigate operational noise levels at nearby sensitive receptors, particularly R02. The indicative noise barrier location was previously identified in Figure 2.

The barrier heights considered in this acoustic assessment are 6.2 metres. This barrier height may be achieved through a standalone barrier, or through a combination of an earthwork bund with a barrier on top of it. The height should be determined compared to the current natural ground level.

All noise barriers considered for this project are assumed to be constructed without gaps and have a minimum surface density of 12.5 kg/m^2 to ensure effective barrier design. The alternate access marked on the plans would introduce a break in the barrier, but AE has determined that this does not appreciably increase the receptor noise levels.

6.3.4.2 Sound Power Level Restrictions

The sound power levels applied for equipment in this assessment were previously presented in Table 5, being:

- BESS: 85.3 dB(A);
- Inverters: 87.0 dB(A); and
- Transformers: 83.6 dB(A).

Detailed equipment selections have not been made at this stage of the project, and it is understood that there may be changes in technology that result in either existing equipment reducing in sound level, or the occurrence of new, quieter equipment in the future. As such, no specific equipment has been nominated in this assessment, instead relying on noise data for typical equipment currently available on the market. AE recommends that the equipment

selections be guided by the above maximum sound power levels. To ensure compliance, final selections should be verified by an acoustical consultant. This is necessary as different equipment models may have substantially different directivity and spectral components even if they have identical sound power levels.

6.3.5 Cumulative Operational Assessment

In a similar manner to the cumulative construction assessment, with no EIS prepared there is insufficient information to prepare a detailed cumulative assessment. However, the same approach as construction can be employed whereby there is no potential for cumulative impacts if the contribution from the Subject Site is 10 dB or more below the assessment criteria. For operational impacts, this threshold is 25 dB(A), being 10 dB less than the night criteria of 35 dB(A).

A review of the predicted operational noise levels identifies the only receptors with predicted noise levels greater than 25 dB(A) are R01 and R02. At all other receptors, the contribution from the Subject Site when considered cumulatively would not result in exceedances of the project criteria.

At R01 and R02, AE notes that the impacts of a project on an associated receptor are typically not considered, thus no consideration of cumulative impacts is warranted for either receptor. As a result, an acceptable outcome is reached for all receptors.

7 CONCLUSION

AE was appointed by Silo Energy to undertake a Noise and Vibration Impact Assessment for the proposed BESS facility at 477 Gregadoo East Road, Gregadoo (the Subject Site). The proposed BESS comprises 1024 batteries for a total capacity of 1 GW.

The noise and vibration assessment included both the construction and operational phases of the Subject Site and included all noise sources related to the site.

The assessment of potential noise impacts has considered the construction phase should occur during standard hours only.

The results of first-principle calculations of predicted noise levels at nearby sensitive receptors due to construction activities demonstrate that the Noise Affected criteria of 45 dB(A) is expected to be exceeded at a number of residential locations depending on the construction stage. The Highly Noise Affected criteria of 75 dB(A) is not expected to be exceeded at any locations.

As such, for construction during standard hours, adverse amenity impacts during construction are considered unlikely. During works, following best practice mitigation detailed in Section 6.2.2 is recommended to ensure the amenity of the area is preserved.

The assessment of potential vibration emissions from the Subject Site during construction were also conducted. Detailed assessment of impacts during the construction phase identified adverse amenity impacts from vibration emissions to be unlikely and compliance with applicable criteria is expected to be achieved.

During the operational phase of the Subject Site, vibration emissions are considered negligible due to the nature of the BESS equipment and minimal staff vehicle volumes during the operational phase.

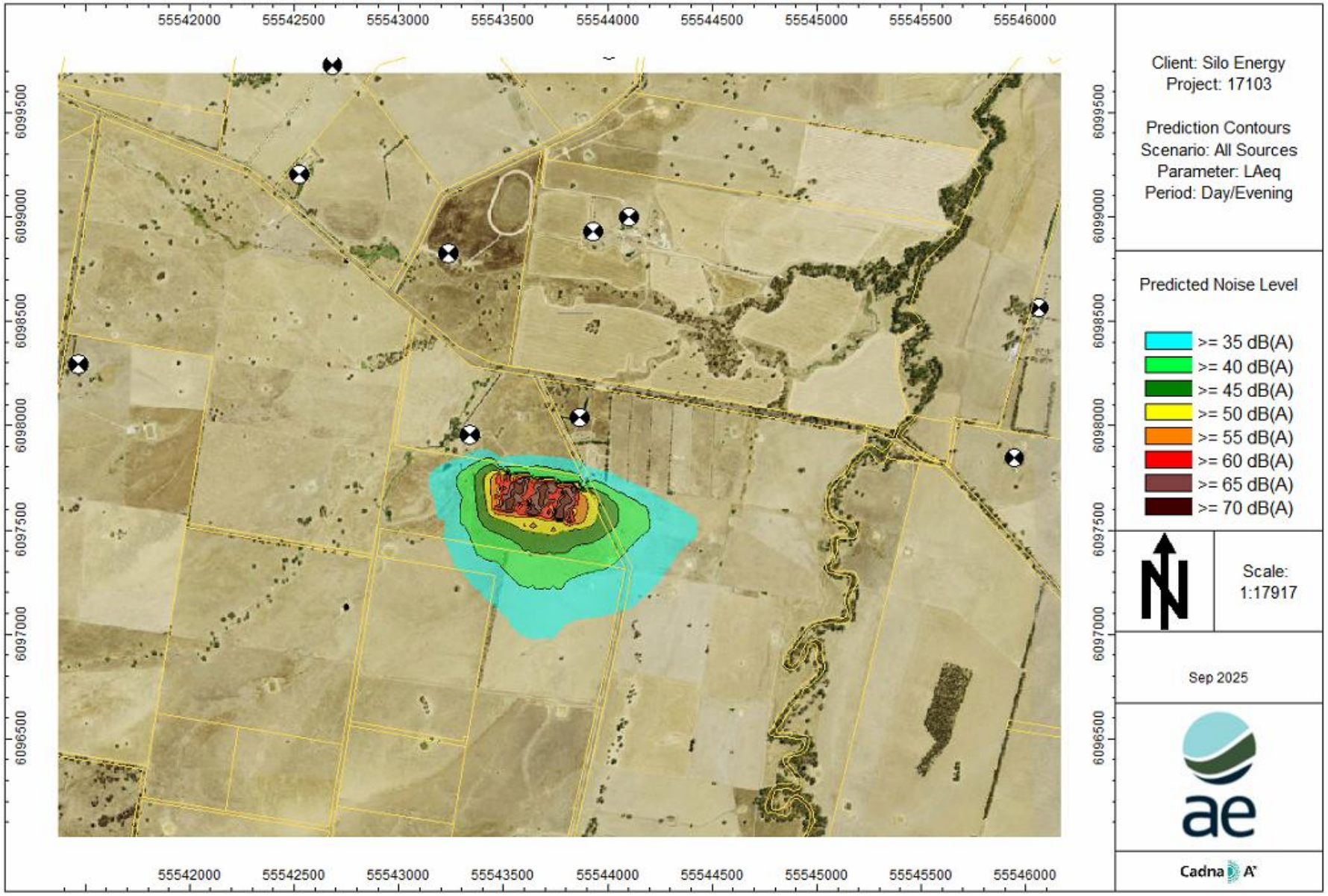
The results of the predictive noise modelling for the operational phase of the Subject Site demonstrate that compliance with the derived noise criteria, being 40 dB(A) during the day and 35 dB(A) during the evening and night, is expected to be achieved at all identified sensitive receptors. This compliance incorporates mitigation in the form of noise barriers and maximum sound power level restrictions as discussed in Section 6.3.4.

As such, the Subject Site is unlikely to cause adverse amenity impacts during operation and can be considered a suitable location for the proposed development.

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 and vibrational perspective, the proposed Subject Site is considered acceptable for the proposed use.

APPENDIX A: NOISE ISOPLETHS

Isopleths illustrate the spatial distribution of predicted noise levels across the modelling domain for each time period and height of interest. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the isopleths and receptor model predictions.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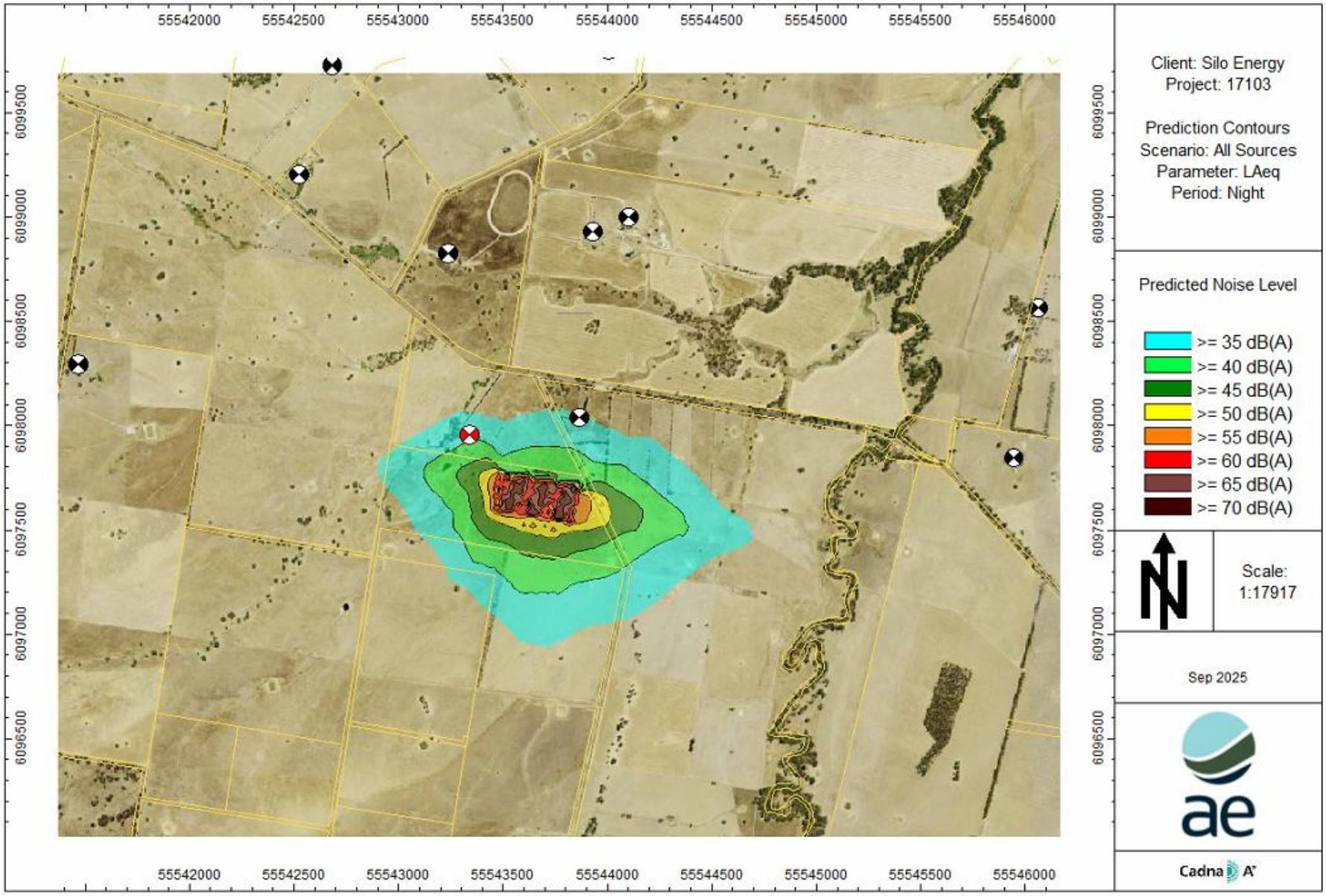
Client: Silo Energy
Project: 17103
Prediction Contours
Scenario: All Sources
Parameter: LAeq
Period: Day/Evening
Predicted Noise Level
>= 35 dB(A)
>= 40 dB(A)
>= 45 dB(A)
>= 50 dB(A)
>= 55 dB(A)
>= 60 dB(A)
>= 65 dB(A)
>= 70 dB(A)
Scale:
1:17917
Sep 2025
Cadna A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Client: Silo Energy
Project: 17103
Prediction Contours
Scenario: All Sources
Parameter: LAeq
Period: Night
Predicted Noise Level
>= 35 dB(A)
>= 40 dB(A)
>= 45 dB(A)
>= 50 dB(A)
>= 55 dB(A)
>= 60 dB(A)
>= 65 dB(A)
>= 70 dB(A)
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Scale:
1:17917
Sep 2025
Cadna A