Appendix V

Light Spill Assessment

Battery Energy Storage System - Jindera

FOR: **BESS Atlantic Pty Ltd** c/o Gransolar Development Australia Pty Ltd

SLR PROJECT No: 620.041088.00013 Revision: 1.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	8 May 2025	Peter Hayman	Neihad Al-Khalidy	Neihad Al-Khalidy
0.1	1 November 2024	Peter Hayman	Neihad Al-Khalidy	

Basis of Report

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

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

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

Executive Summary

SLR consulting Australia Pty Ltd has been engaged by BESS Atlantic to qualitatively assess the lighting environment around a proposed Battery Energy Storage System (BESS) facility outside Jindera NSW.

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by the Australian Standard: *AS 4282-2023 Control of the Obtrusive Effect of Outdoor Lighting.*

The following assumptions have been made regarding the lighting fixtures to be used for the Project Site:

- Areas that may require lighting are the entrance to the Project Site from Ortlipp Road and the ends of the battery rows.
- Lighting will likely be pole or wall mounted and directed downward to illuminate any required areas.
- The mounting heights for any lights are expected to range between 4 m and 6 m.
- The maximum luminous intensity will be less than or equal to 1000 Cd as per Table 3.

Taking the expected design, surrounding sensitive receivers, and general location into account, SLR is of the opinion that while the proposed site lighting may be viewed from some locations, there will not be any light spill above the AS4282-2023 requirements at the given assessment lines or surrounding residential dwellings.

The following principles should be applied during the detailed design stage when designing the site lighting.

- Direct lights downward as much as possible.
- Use luminaires that are aimed to minimise light spill, e.g. full cut off luminaires where no light is emitted above the horizontal plane. Less spill light means that more of the light output can be used to illuminate the area and a lower power output can be used. The energy consumption for the fitting can thus be reduced without decreasing the illuminance of the area. Refer Figure 5.
- Do not waste energy and increase light pollution by over-lighting.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.
- Lighting should be aimed inward in the middle of the site where possible and away from the site boundaries.

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1.0 Introduction

BESS Atlantic Pty Ltd (BESS Atlantic) c/o Gransolar Development Australia (GDA) Pty Ltd seeks to establish a Battery Energy Storage System (BESS) facility with a connection to the electricity grid via an above ground transmission line (TL) to the existing Transgrid JINDERA 330/132 kilovolt (kV) Transmission Substation (TS) (herein referred to as the 'Project').

The BESS is proposed on a portion of Lot 204 DP 753342 at 204 Ortlipp Road, Glenellen New South Wales (NSW) 2642 (the 'BESS Site'). The existing JINDERA 330/132 kV TS is located on Lot 1 DP 588720, 140 Ortlipp Road, Jindera NSW 2642 (the 'Substation Site'), approximately 500m south of the BESS Site and proposes upgrade work and the TL will traverse an area of unformed crown road. The existing Council watermain will be upgraded and extended along Lindner and Ortlipp Road. Collectively, these properties are hereafter referred to as the 'Subject Sites.'

The BESS has a capacity of 250MW / 500 MWh and comprises of 200 lithium batteries, each contained individually within a modular container. A total of 100 inverters (one per every two batteries) will be located externally to the modular containers. Batteries and inverters are fixed to hardstand footings where they are accessible by an internal road.

Other physical features of the Project include a TL towers, control room/switchgear and auxiliary transmission, acoustic wall, car parking, landscaping, security fencing/lighting, and a single storage structure.

1.1 Site and Surrounds

The BESS is proposed on Lot 204 DP 753342 at 204 Ortlipp Road, Glenellen New South Wales (NSW) 2642 (BESS Site). The existing JINDERA 330/132KV Transmission Substation (TS) that the BESS would be connected to via overhead line is located on Lot 1 DP 588720, 140 Ortlipp Road, Jindera NSW 2642 (Substation Site), approximately 500m south of the BESS site. The TL will traverse an area of unformed Crown Road reserve, which is located between the BESS Site and Substation Site.

The regional context of the Subject Site is shown in

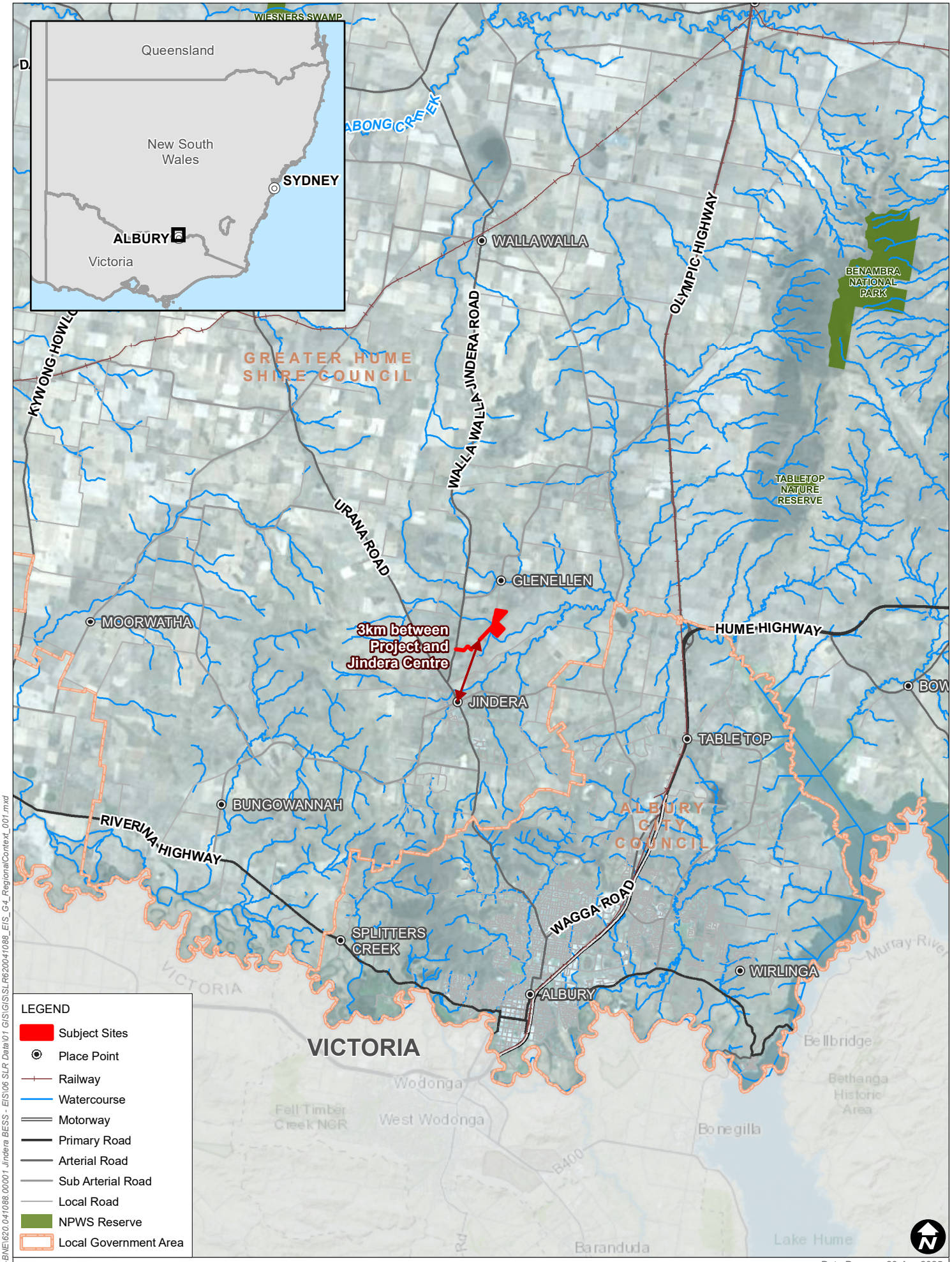
Figure 1, and the Project Areas are shown in Figure 2 and Figure 3.

The BESS Site will be leased from the landowner. Lot 204 DP 753342 is currently agricultural in nature with supporting structures, however no farming is currently taking place on the BESS site.

The area to which the project relates, hereafter referred to as the Subject Sites, and comprises:

- Lot 204 DP753342 , which is the 'BESS Site' (private land owner);
- Lot 1 on DP588720, which is the 'Substation Site' (owner by Transgrid);
- An area of unformed Crown road reserve (owned by Crown Lands); and
- Ortlipp Road and Lindner Road road reserves (owned by Greater Hume Council and Crown Lands).

A residential dwelling has recently been approved on the BESS Site and is noted as the 'host receiver' (H1) on the sensitive receiver's map (Figure 4). No other development applications have been lodged or approved on the Subject Sites.



Scale: 1:220,000 at A4
Coordinate System: GDA2020 MGA Zone 55

Date Drawn: 23-Apr-2025
Project Number: 620.041088

Data Source: Basedata supplied by NSW SS, June 2024
Aerial imagery and base supplied by ESRI and other sources

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Regional Context of the Site

FIGURE 1

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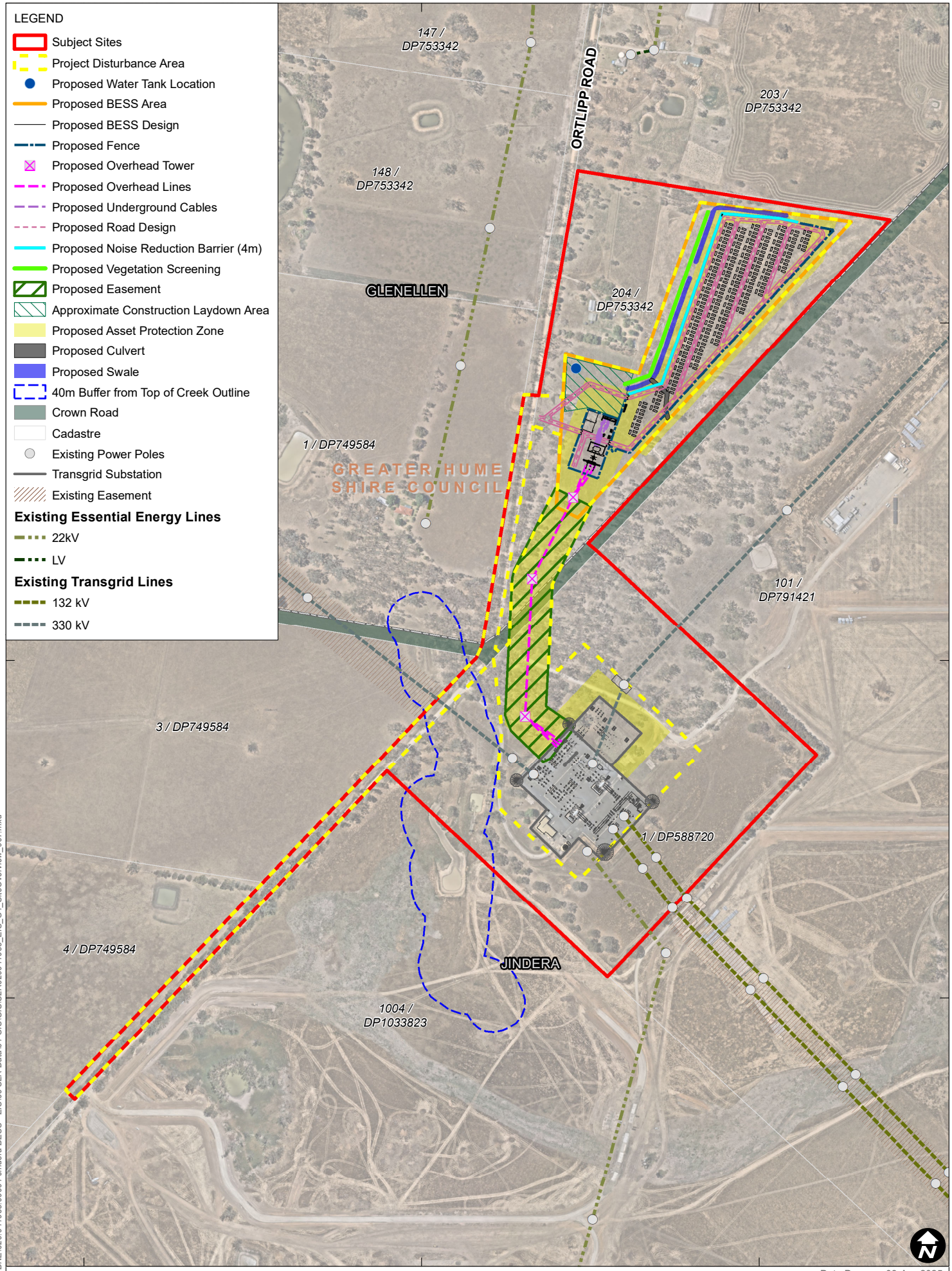

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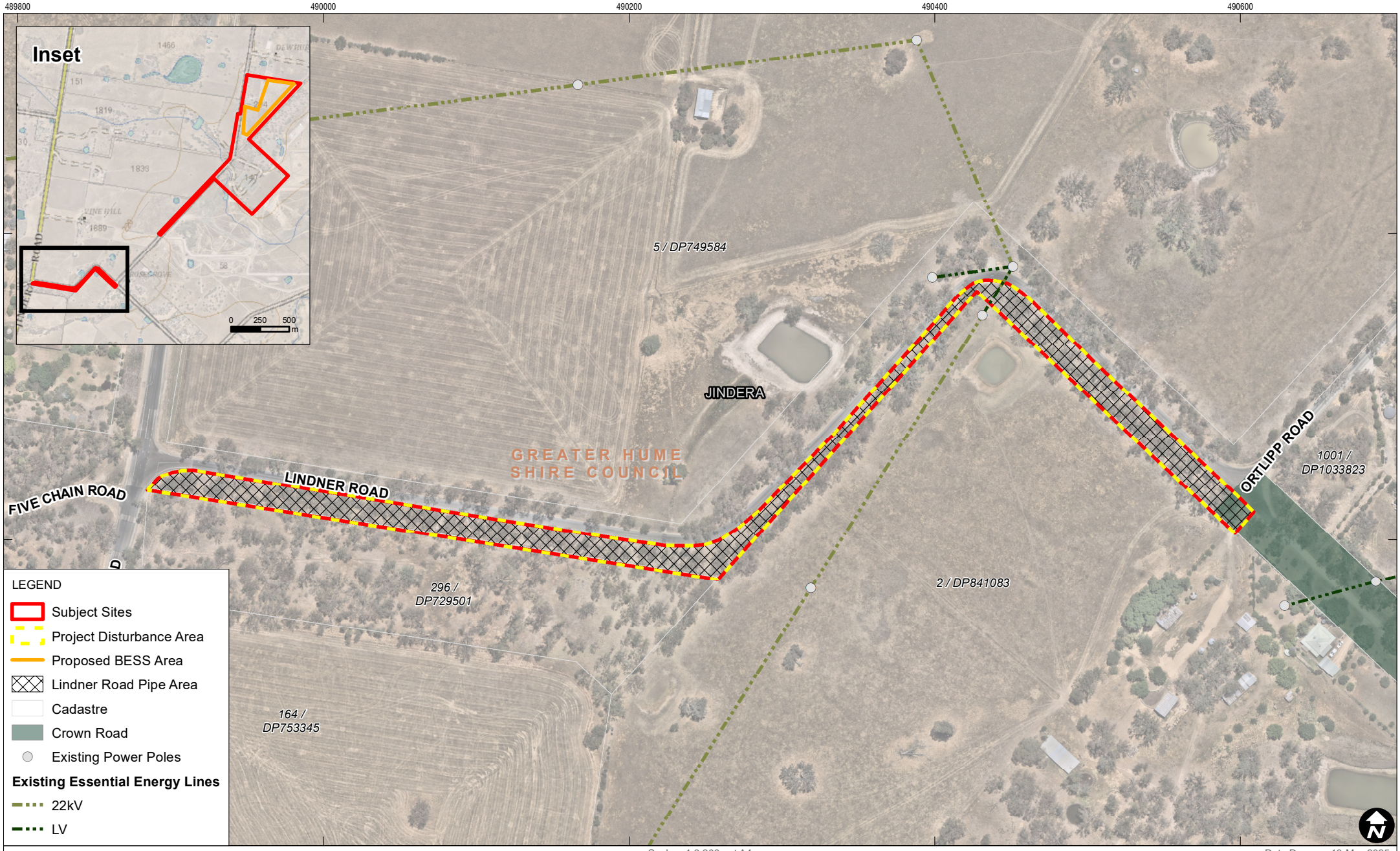
Data Source: basedata supplied by NSW SS, June 2024
Aerial imagery supplied by Nearmap, November 2024
Other data sources include Gransolar Group, Look up & Live (LUAL)

Site Overview

FIGURE 2



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Coordinate System: GDA2020 MGA Zone 55

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Data Source: basedata supplied by NSW SS, June 2024
Aerial imagery supplied by Nearmap, November 2024
Other data sources include Gransolar Group, Look up & Live (LUAL)

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Lindner Road Overview

FIGURE 3

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1.2 Project Description

BESS Atlantic Pty Ltd (BESS Atlantic) c/o Gransolar Development Australia (GDA) Pty Ltd seeks to establish a Battery Energy Storage System (BESS) facility with a connection to the electricity grid via an above ground transmission line (TL) to the existing Transgrid JINDERA 330/132 kilovolt (kV) Transmission Substation (TS) (herein referred to as the 'Project').

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The BESS has a capacity of 250MW / 500 MWh and comprises of 200 lithium batteries, each contained individually within a modular container. A total of 100 inverters (one per every two batteries) will be located externally to the modular containers. Batteries and inverters are fixed to hardstand footings where they are accessible by an internal road.

Other physical features of the Project include a TL towers, control room/switchgear and auxiliary transmission, acoustic wall, car parking, landscaping, security fencing/lighting, and a single storage structure.

2.0 Lighting and Light Spill

2.1 Background

SLR has been engaged to provide comments on the light emanating from the site with regard to the surrounding environment.

SLR will qualitatively assess the site lighting and signage against AS 1158 and the light spill potential against AS 4282:2023.

2.2 Lighting Terminology

A description of the common terminology used for the lighting study, taken from *AS 4282:2023 Control of the Obtrusive Effects of Outdoor Lighting,* is shown in Table 1.

Table 1 Lighting Terminology (Consistent with AS4282)

Obtrusive light	Spill light which, because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information, eg: traffic lights.
Spill light	Light emitted by a lighting installation which falls outside the boundaries of the property on which the installation is sited.
Residential property	Land upon which a dwelling exist or may be developed, eg: land zoned for residential development.
Dwelling	A building in which people normally reside, especially during the hours of darkness, eg house, hotel, motel, hospital.
Illuminance	The luminous flux arriving at a surface divided by the area of the illuminated surface. Unit: lux(lx); 1 lx = 1 lm/m^2
Luminous intensity	The concentration of luminous flux emitted in a specific direction. Unit: candela (cd).
Luminous flux	The measure of the quantity of light. For a lamp or luminaire it normally refers to the total light emitted irrespective of the directions in which it is distributed. Unit: lumen (lm).
Luminaire	Apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except for the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary circuit auxiliaries together with the means for connecting them to the electrical supply.
Glare	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision Disability Glare – Glare that impairs the visibility of objects without necessarily causing discomfort. Discomfort Glare – Glare that causes discomfort without necessarily impairing the visibility of objects.

2.3 Light Spill Effects

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by the Australian Standard: *AS 4282-2023 Control of the Obtrusive Effect of Outdoor Lighting.*

The obtrusive effects of light spill are due both to an increase in general illuminance that can lead to sleep deprivation, and from the direct view of the light source that can cause glare issues.

The adverse effects of light spill from outdoor lighting are influenced by a number of factors:

- The topology of the area.
    - Light spill is more likely to be perceived as obtrusive if the lighting installation is located higher up than the observer. Lighting installations are usually directed towards the ground and an observer would hence have a direct view of the luminaire.
- The surrounding area.
    - Hills, trees, buildings, fences and general vegetation have a positive effect by shielding the observer from the light installation.
- Pre-existing lighting in the area.
    - Light from a particular light source is seen as less obtrusive if it is located in an area where the lighting levels are already high, eg in cities. The same lighting installation would be seen as far more bothersome in a dark residential area.
- The zoning of the area.
    - A residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.

Typical illuminance levels for a variety of circumstances are given in Table 2 for comparison.

Table 2 Typical Illuminance Levels for Various Scenarios

Lighting Scenario	Horizontal Illuminance (lux)
Moonless overcast night	0.0001
Quarter Moon	0.01
Full Moon	0.1
Twilight	10
Indoor office	300
Overcast day	1,000
Indirect sunlight clear day	10,000-20,000
Direct sunlight	100,000-130,000

3.0 Project Lighting and Requirements

3.1 Proposed Lighting

At this stage there are no detailed plans for the lighting system of the site. As such SLR has taken a conservative approach and assumed that a lighting system will be required to be operational at night-time. Typical lighting for the project would include modest amounts of lighting for security as well as for the safe movement of vehicles and pedestrians around the BESS equipment.

3.2 Area Zoning

Initially the environmental zone of the site and surrounding area should be determined. This is defined in Table 3.1 of AS/NZS 4282-2023. The areas surrounding the Project Site are on the outskirts of Jindera with semi-rural properties to the south nearer the town and rural properties in most other directions. In relation to AS/NZS 4282-2023, the relevant environmental zones for the area are considered to be:

- A2 (Low District Brightness) for the rural and semi-rural dwellings.

3.3 Light Spill

The maximum recommended values of light technical parameters for the control of obtrusive lights are given in Table 3.

Table 3 Recommended Maximum Values of Light Technical Parameters (AS4282:2023 Table 3.2)

Light Technical Parameter	Time of Operation	Zone "A4"	Zone "A3"	Zone "A2"	Zone "A1"	Zone "A0"
Illuminance in vertical plane (E_v)	Pre-curfew hours	25 lx	10 lx	5 lx	2 lx	ALARP [2]
	Curfew hours [1]	5 lx	2 lx	1 lx	0.1 lx	0 lx
Luminous Intensity emitted by luminaires (I)	Pre-curfew hours	25,000 Cd	12,500 Cd	7,500 Cd	2,500 Cd	ALARP [2]
	Curfew hours [1]	2,500 Cd	2,500 Cd	1,000 Cd	500 Cd	0 Cd

Zone A0	"Intrinsically Dark", e.g. UNESCO Starlight Reserve; IDA Dark Sky Parks; major optical observatories; no road lighting, unless specifically required by the relevant road controlling authority.
Zone A1	"Dark", e.g. relatively uninhabited rural areas; no road lighting, unless specifically required by the relevant road controlling authority.
Zone A2	"Low District Brightness", eg sparsely inhabited rural and semi-rural areas.
Zone A3	"Medium District Brightness", eg suburban areas in towns and cities
Zone A4	"High District Brightness", eg town and city centres and other commercial areas; residential areas abutting commercial areas

Note 1 Curfew Hours = 11;00 pm to 6:00 am

Note 2 ALARP = as low as reasonably practical (as close to zero as possible)

Limits for luminous intensity for curfew hours apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents from positions where such views are likely to be maintained.

Limits for luminous intensity for pre-curfew hours apply to each luminaire in the principal plane, for all angles at and above the control direction.

The relevant limits in Table 3 are:

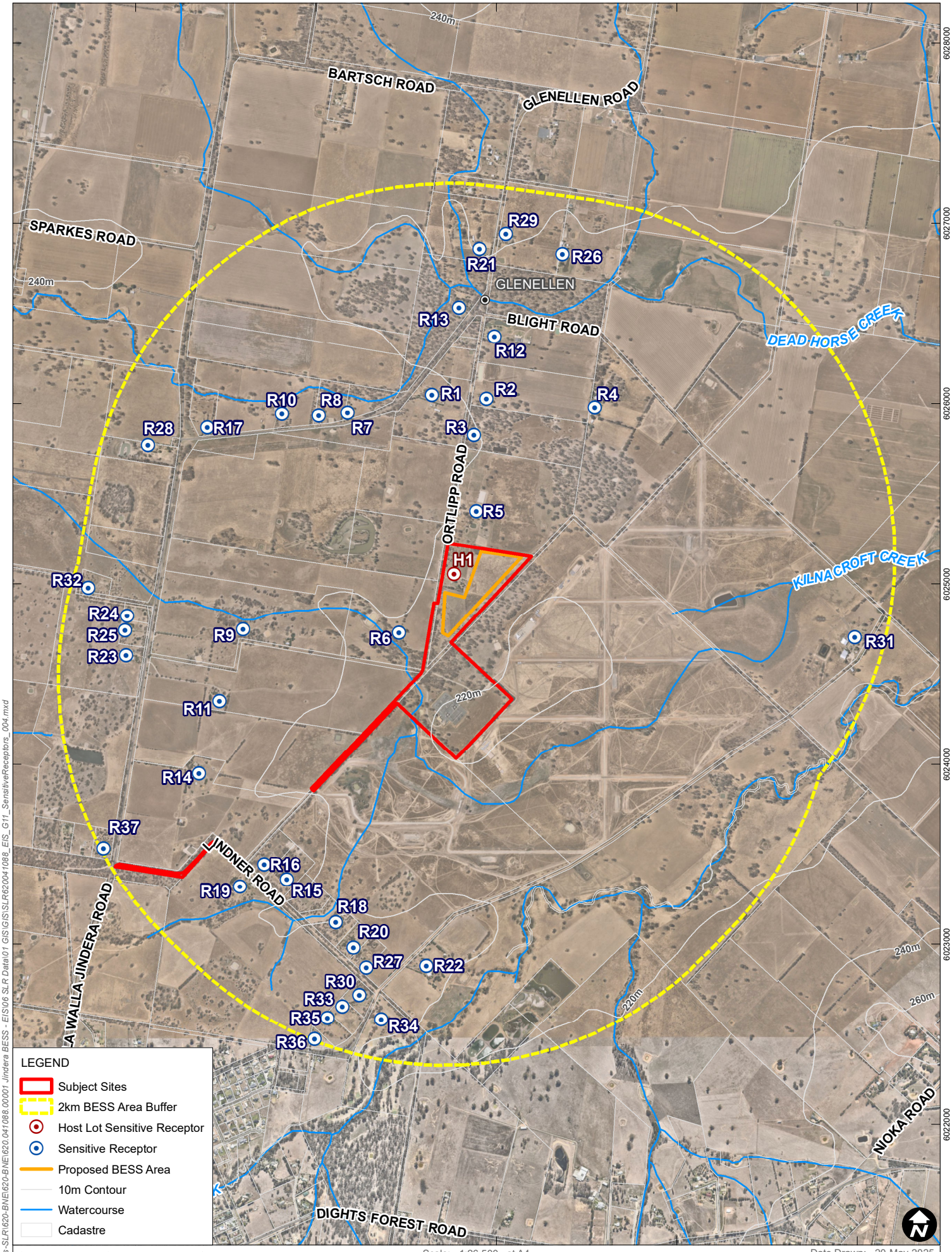
- Zone A2
  - 5 lux Pre-Curfew
  - 1 lux for Curfew times

The following guidance is made relevant to the recommended illuminance limits:

- The vertical illuminance limits for curfew hours apply in the plane of the windows of habitable rooms or dwellings on nearby residential properties when they are less than 10m from the property boundary.
  - This refers to windows looking out toward the site as opposed to a horizontal measurement, which would be parallel to the ground looking up.
  - If the facades are more than 10m from the boundary, the vertical illuminance limits will apply at that 10m line, facing toward the site.
- The vertical illuminance criteria for pre-curfew hours apply at the boundary of nearby residential properties in a vertical plane parallel to the boundary.
  - Values given are for the direct component of illuminance, i.e. no reflected light is considered.

4.0 Sensitive Receivers

Residential properties to be qualitatively assessed have been identified – refer Figure 4 and Table 4. The closest dwellings to the proposed Project Site are the Host Lot (H1), approximately 135 metres from the nearest Project Site equipment and Sensitive Receivers R5 and R6, approximately 230 metres from the boundary of the Project Site.



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Data Source: Basedata supplied by NSW SS, June 2024
Aerial imagery supplied by Nearmap, November 2024
Other data sources include Gransolar Group, Look up & Live (LUAL)

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SENSITIVE RECEPTOR PLAN

FIGURE 4

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Table 4 Sensitive Receiver Addresses

Receptor ID	Address	Distance to Site Centroid, m
H1	204 Ortlipp Road, Glenellen	382
R1	128 Glenellen Rd, Glenellen	1,090
R2	304 Ortlipp Rd, Glenellen	1,060
R3	284 Ortlipp Rd, Glenellen	850
R4	66 Blight Rd , Glenellen	1,230
R5	238 Ortlipp Rd, Glenellen	420
R6	151 Ortlipp Rd, Glenellen	500
R7	95 Glenellen Road, Glenellen	1,503
R8	73 Glenellen Road, Glenellen	1,595
R9	1819 Walla Walla Jindera Road, Glenellen	1,337
R10	51 Glenellen Road, Glenellen	1,721
R11	1833 Walla Walla Jindera Road, Glenellen	1,542
R12	336 Ortlipp Road, Glenellen	1,873
R13	185 Glenellen Road, Glenellen	2,044
R14	1889 Walla Walla Jindera Road, Glenellen	1,857
R15	99 Lindner Road, Jindera	1,898
R16	91 Lindner Road, Jindera	1,922
R17	11 Glenellen Road, Glenellen	2,002
R18	141 Lindner Road, Jindera	2,012
R19	96 Lindner Road, Jindera	2,129
R20	159 Lindner Road, Jindera	2,126
R21	219 Glenellen Road, Glenellen	2,419
R22	254 Drumwood Road, Jindera	2,126
R23	1889 Walla Walla Jindera Road, Jindera	2,073
R24	11 Klinberg Road, Jindera	2,050
R25	1816 Walla Walla Jindera Road, Jindera	2,082
R26	208 Glenellen Road, Glenellen	2,481
R27	173 Lindner Road, Jindera	2,204
R28	1816 Walla Walla Jindera Road, Jindera	2,263
R29	232 Glenellen Road, Glenellen	2,516
R30	211 Drumwood Road, Jindera	2,393
R31	535 Drumwood Road, Jindera	2,539
R32	36 Klinberg Road, Jindera	2,326
R33	197 Drumwood Road, Jindera	2,494
R35	204 Drumwood Road, Jindera	2,521

Receptor ID	Address	Distance to Site Centroid, m
R36	185 Drumwood Road, Jindera	2,595
R37	12 Five Chain Road, Jindera	2,500

5.0 Light Spill Analysis

5.1 Night-time Light Spill

As stated, a conservative approach has been taken with the light expected to be operational at night-time. As the nighttime impacts are being assessed, the curfew limits will be applied.

The following has been assumed:

- Areas that may require lighting are the entrance to the Project Site from Ortlipp Road and the ends of the battery rows.
- Lighting will likely be pole-mounted and directed downward to illuminate any required areas.
- The mounting heights for any lights are expected to range between 4m and 6m.
- The maximum luminous intensity will be less than or equal to 1000 Cd as per Table 3.
- As the dwellings are more than 10 metres from the boundary, this 10-metre line will be used for the assessment.

On the basis of the above, it is SLR's opinion that:

- Due to the minimal amount of lighting expected to be present on the BESS Site and the distances involved, there is minimal to nil risk of any light spill above the critical 1 lux limit at the assessment line defined above and the facades of the nearest surrounding sensitive receivers.

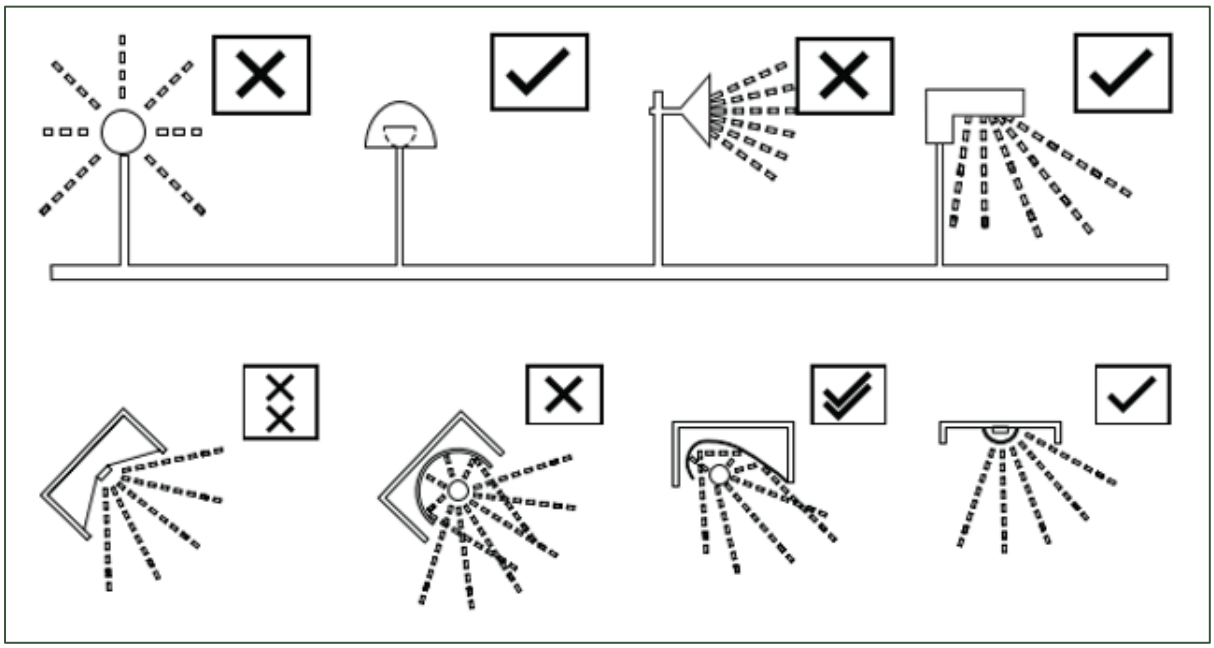
It is possible that some lighting fixtures may be able to be seen from some dwellings, however the impact of this is considering negligible due to the intervening distances and other shielding elements.

5.2 General Mitigation

AS/NZS 4282-2023 *Control of the Obtrusive Effect of Outdoor Lighting* sets out general principles that should be applied when designing outdoor light to minimise any adverse effect of the light installation. Even though a negligible impact is expected the following principles should still be applied when designing the site lighting.

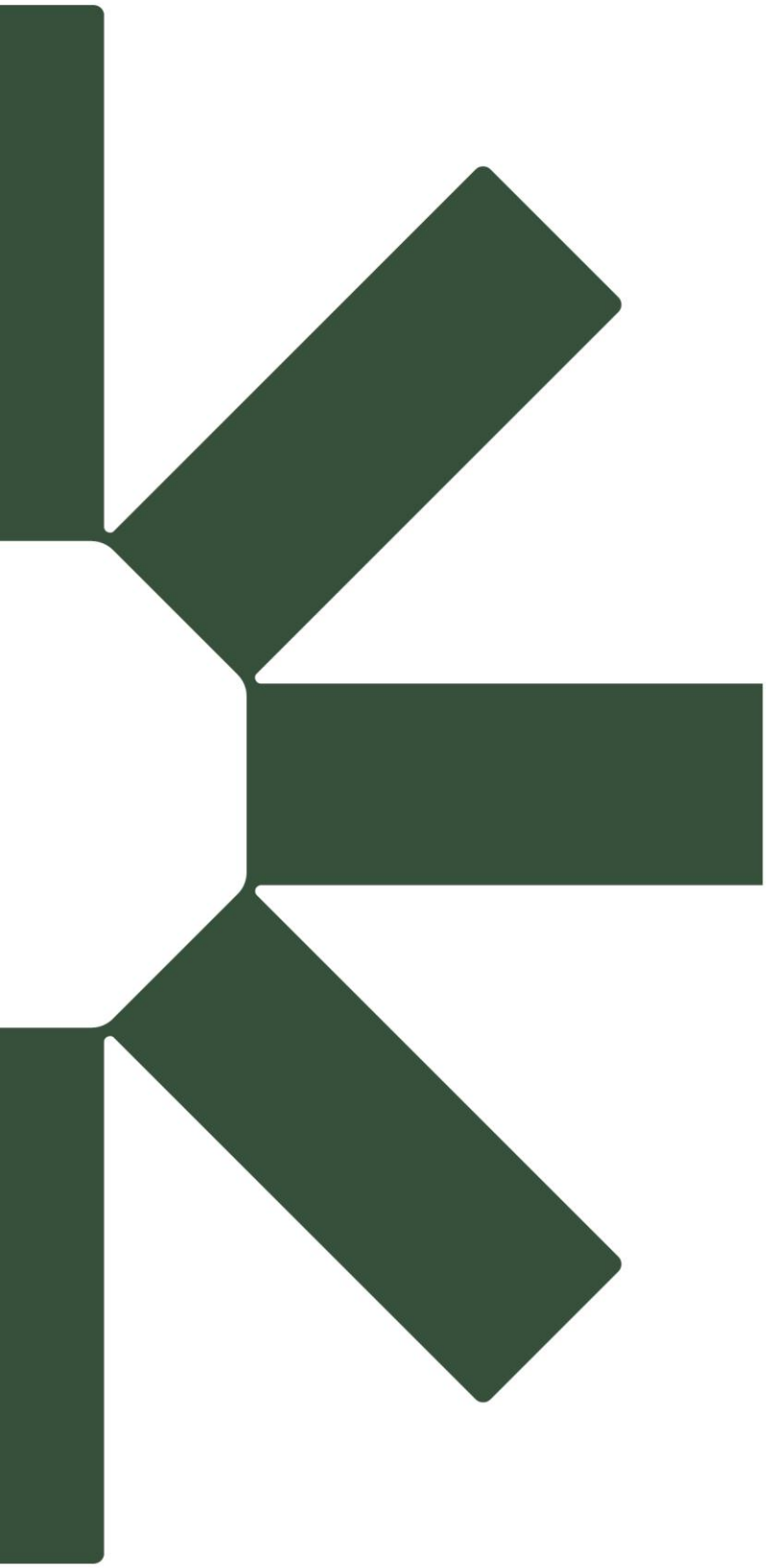
- Direct lights downward as much as possible.
- Use luminaires that are aimed to minimise light spill, e.g. full cut off luminaires where no light is emitted above the horizontal plane. Less spill light means that more of the light output can be used to illuminate the area and a lower power output can be used. The energy consumption for the fitting can thus be reduced without decreasing the illuminance of the area. Refer Figure 5.
- Do not waste energy and increase light pollution by over-lighting.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.
- Lighting should be aimed inward the middle of the site where possible and away from the site boundaries.

Figure 5 Design Features to Minimise Light Spill



6.0 Conclusion

Based on a conservative assessment and assumptions aligned with AS/NZS 4282:2023, the proposed lighting associated with the Jindera BESS is not expected to result in light spill exceeding allowable thresholds at nearby sensitive receptors. While some lighting may be visible from surrounding properties, impacts are considered negligible due to distance, limited lighting intensity, and the presence of intervening vegetation and built features. Adherence to best-practice lighting design principles during detailed design will ensure light impacts remain minimal and compliant with relevant standards.



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