Appendix G

Addendum visual impact assessment

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Birriwa Solar and Battery Project

Modification Report 1 - Landscape and Visual Impact Assessment

Prepared for ACEN Australia Pty Ltd

June 2025

Birriwa Solar and Battery Project

Modification Report 1 - Landscape and Visual Impact Assessment

ACEN Australia Pty Ltd

E240117 RP#14

June 2025

Version	Date	Prepared by	Reviewed by	Comments
1	7 May 2025	Stephen Bertram	Tadd Andersen Nicole Armit	ACEN review
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Approved by

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4 June 2025

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Executive Summary

ES1 Introduction

ACEN Australia Pty Ltd (ACEN) has approval to develop the Birriwa Solar and Battery Project, a large scale solar photovoltaic (PV) electricity generation facility along with battery storage and associated infrastructure, including the construction of a temporary accommodation facility (the project). The solar component of the project will have an indicative capacity of around 600 megawatts (MW) and will include a centralised battery energy storage system (BESS) of up to 600 MW for a two-hour duration (1,200 MWh). The project (SSD-29508870) was approved on 16 August 2024 by the NSW Independent Planning Commission, with development consent conditions.

The project site is approximately 15 kilometres (km) south-east of Dunedoo, in the Central-West Orana (CWO) region of New South Wales (NSW), in the localities of Birriwa and Merotherie (refer to Figure 1.1). It is situated within the Mid-Western Regional Local Government Area (LGA). Part of the transport access route to the project site via the Castlereagh Highway is situated within the Warrumbungle Shire LGA. The project is within the CWO Renewable Energy Zone (REZ).

ACEN Australia is seeking approval to modify development consent SSD-29508870 to include additional lots, an alternative access route and upgrade to part of the existing Birriwa Bus Route South, and increase in the capacity of the BESS at location option B, and an increase in capacity of the approved temporary accommodation facility.

This Landscape and Visual Impact Assessment Report has been prepared as part of the modification report to support the application to modify SSD-29508870.

ES2 Approved project

The approved project is shown on Figure 1.3 and comprises the following key components:

- installation of approximately 1 million solar PV panels and associated mounting infrastructure
- a BESS with a capacity of up to 600 MW and a storage duration of up to 2 hours (1,200 MWh)
- an on-site substation with a connection voltage of up to 500 kilovolts (kV)
- electrical collection and conversion systems, including inverter and transformer units, switchyard, control room and staff car park
- underground and aboveground cables
- an operational infrastructure area, including demountable and permanent offices, amenities, and equipment sheds
- internal access roads
- a temporary construction compound (during construction and decommissioning phases)
- an access route upgrade from Castlereagh Highway to the project site via Barneys Reef Road and Birriwa Bus Route South
- a temporary accommodation facility to provide accommodation for up to 500 construction staff during the construction phase of the project
- an emergency access track providing alternative access to the accommodation facility, suitable for emergency vehicles.

ES3 Proposed modifications

ACEN is seeking to modify SSD-29508870, pursuant to Section 4.55(2) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) to:

- Increase the project area and development footprint to include three additional lots (Lot 11/DP 750755, Lot 40/DP 750755, Lot 60/DP 750755) and the remaining part of Lot 34/DP 750755, allowing for additional land to be used for solar generation, BESS, and associated ancillary infrastructure, as needed. Modifying the project area and development footprint across additional neighbouring lots will enable flexibility in design and construction, optimisation of the solar array layout, and will allow sufficient space for maintenance.

- Increase the storage capacity and duration of the BESS from up to 600 MW for a 2-hour duration up to 900 MW for a 4-hour duration. The additional capacity will allow the project to increase its energy storage potential, providing additional firming support and greater network system strength.

- Increase the project area and development footprint to allow for an upgrade to part of the existing Birriwa Bus Routh South Road from the Golden Highway via Merotherie Road as an alternative access route. It also includes a public road crossing along Birriwa Bus Route South to allow construction and operation traffic to access different areas of the project with limited impacts on Birriwa Bus Route South. This upgrade will enable access to the project for the purpose of constructing and operating the approved temporary accommodation facility, as well as the BESS. Oversize over mass vehicles will continue to access the project area via the approved primary access point (i.e. Castlereagh Highway-Barney's Reef Road-Birriwa Bus Route South).

- Increase the approved project's accommodation facility capacity from 500 workers to 650 workers, within the approved accommodation footprint (up to an additional 150 workers will reside at the accommodation facility in peak construction periods).

- Amend the schedule of land to include three additional neighbouring lots.

- Increase the total number of daily vehicle movements to and from the site during pre-construction and construction, from 120 to 156 daily heavy vehicle trips, split between the approved access via Barneys Reef Road and the proposed alternative access via Merotherie Road. Correction of wording errors in the consent conditions from "vehicle movements" to "vehicle trips".

The modification area is shown on Figure 1.2.

This LVIA report provides an assessment of the visual impacts associated with the proposed modification.

ES4 Landscape and visual impact assessment

This LVIA has assessed the potential visual impact of the infrastructure associated with the proposed modification. Three main parts of the assessment were:

- visual baseline study

- landscape character assessment

- visual impact assessment.

The key findings of each are described below.

ES4.1 Visual baseline study

The existing visual environment is characterised by historic and ongoing rural land uses on a landscape with gently rolling topography. Watercourses, roads and windbreaks accommodate a mix of remnant native and exotic trees. Woody vegetation is also common on ridges and outcrops such as Barneys Reef.

The modification area is largely cleared pasture land with some woody vegetation and minor watercourses.

ES4.2 Landscape character assessment

Within the landscape character assessment boundary two landscape character zones were identified:

- agricultural plains
- forested ridges.

Visual impacts of the modification on each landscape character zone (LCZ) were assessed as low for the agricultural plains LCZ and low – moderate for the f ridges LCZ.

ES4.3 Visual impact assessment

Sixteen private and four public viewpoints were identified in the visual study area. Based on viewshed mapping eight private and four public viewpoints were selected for assessment in this LVIA. Potential visual impacts have been assessed as very low for all viewpoints.

Key findings of the assessment are:

- the modification infrastructure will be difficult to see from any public viewpoints other than nearby locations on Birriwa Bus Route South
- the highest anticipated visual impact rating for any private or public receiver is very low.

ES4.3.1 Glint and glare assessment

Based on the glare analysis, the modification will not produce glare at any of the assessed receptors. No locations, residences or flight paths will have potential glare impacts.

ES4.3.2 Nighttime visual impacts

The modification is within the Siding Springs Dark Sky Region and application of good lighting design principles is required.

It is unlikely that the additional ancillary lighting associated with the modification will create a noticeable impact on the existing nighttime lighting environment.

ES4.3.3 Mitigation measures

Because visual impacts have been rated as very low, no additional mitigation measures are required for the modification.

Abbreviations

Item	Definition
BESS	Battery energy storage system
DPHI	Department of Planning, Housing and Infrastructure
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
ha	hectares
HV	high voltage
kV	kilovolt
LCZ	landscape character zone
LGA	local government area
LVIA	Landscape and visual impact assessment
MW	megawatts
MWh	megawatt hour
MWp	megawatt-peak
NA	Not applicable
NSW	New South Wales
SEPP	*State Environmental Planning Policy*
REZ	Renewable Energy Zone
SEARs	Secretary's environmental assessment requirements
SR	sensitive receiver
SSD	State significant development
ZVI	zone of visual influence

Definitions

Item	Definition
Applicant	The applicant of an State significant development (SSD) project seeking consent for a development application or modification application.
Dwelling	A dwelling has the same meaning as the Standard Instrument – Local Environmental Plan (a room or suite of rooms occupied or used as a separate domicile) as well as where it meets the criteria outlined in Section 1.3.
Landscape	A holistic area comprised of its various parts including landform, vegetation, buildings, villages, towns, cities and infrastructure.
Large-scale solar energy development	Works, infrastructure and buildings for the purpose of generating electricity using ground-mounted photovoltaic panels that are State significant development (SSD).
Magnitude	The apparent size of a solar energy project in the landscape or when viewed from a given viewpoint.
Rural dwelling	A dwelling that is located within a rural zoned area (RU1, RU2, RU3, RU4 and RU6), large lot residential zoned area (R5), or environmental or conservation area zone (C2, C3 and C4).
Sensitivity	The capacity of a landscape or viewpoint to absorb the impacts from a proposed land use change and/or built form.
Sensitive viewpoints	Viewpoints that are more sensitive to change than others including dwellings, historic homesteads, tourist accommodation, places of worship, town centres and central business districts.
Urban dwelling	Any dwelling in a residential zoned area (R1, R2, R3 and R4) or rural village (RU5).
View	The sight of a landscape or scene.
Viewpoint	A location within the public or private domain with a potential view of a large-scale solar energy project.
Visual impact	The impact on views from private and public places. It is determined by considering the visual magnitude and sensitivity.

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1 Introduction

ACEN Australia Pty Ltd (ACEN) has approval to develop the Birriwa Solar and Battery Project, a large scale solar photovoltaic (PV) electricity generation facility along with battery storage and associated infrastructure, including the construction of a temporary accommodation facility (the project). The solar component of the project will have an indicative capacity of around 600 megawatts (MW) and will include a centralised battery energy storage system (BESS) of up to 600 MW for a two-hour duration (1,200 MWh). The project (SSD-29508870) was approved on 16 August 2024 by the NSW Independent Planning Commission, with development consent conditions.

The project site is approximately 15 kilometres (km) south-east of Dunedoo, in the Central-West Orana (CWO) region of New South Wales (NSW), in the localities of Birriwa and Merotherie (refer to Figure 1.1). It is situated within the Mid-Western Regional Local Government Area (LGA). Part of the transport access route to the project site via the Castlereagh Highway is situated within the Warrumbungle Shire LGA. The project is within the CWO Renewable Energy Zone (REZ).

ACEN is seeking approval to modify development consent SSD-29508870 to include additional lots, an alternative access route and upgrade to part of the existing Birriwa Bus Route South, and an increase in capacity of the approved temporary accommodation facility.

This Landscape and Visual Impact Assessment (LVIA) report has been prepared as part of the modification report to support the application to modify SSD-29508870.

1.1 Approved project

The approved project is shown on Figure 1.3 and comprises the following key components:

- installation of approximately 1 million solar PV panels and associated mounting infrastructure
- a BESS with a capacity of up to 600 MW and a storage duration of up to 2 hours (1,200 MWh)
- an on-site substation with a connection voltage of up to 500 kilovolts (kV)
- electrical collection and conversion systems, including inverter and transformer units, switchyard, control room and staff car park
- underground and aboveground cables
- an operational infrastructure area, including demountable and permanent offices, amenities, and equipment sheds
- internal access roads
- a temporary construction compound (during construction and decommissioning phases)
- an access route upgrade from Castlereagh Highway to the project site via Barneys Reef Road and Birriwa Bus Route South
- a temporary accommodation facility to provide accommodation for up to 500 construction staff during the construction phase of the project
- an emergency access track providing alternative access to the accommodation facility, suitable for emergency vehicles.

1.2 Proposed modifications

ACEN is seeking to modify SSD-29508870, pursuant to Section 4.55(2) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) to:

- Increase the project area and development footprint to include three additional lots (Lot 11/DP 750755, Lot 40/DP 750755, Lot 60/DP 750755) and the remaining part of Lot 34/DP 750755, allowing for additional land to be used for solar generation, BESS, and associated ancillary infrastructure, as needed. Modifying the project area and development footprint across additional neighbouring lots will enable flexibility in design and construction, optimisation of the solar array layout, and will allow sufficient space for maintenance.

- Increase the storage capacity and duration of the BESS from up to 600 MW for a 2-hour duration up to 900 MW for a 4-hour duration. The additional capacity will allow the project to increase its energy storage potential, providing additional firming support and greater network system strength.

- Increase the project area and development footprint to allow for an upgrade to part of the existing Birriwa Bus Routh South Road from the Golden Highway via Merotherie Road as an alternative access route. It also includes a public road crossing along Birriwa Bus Route South to allow construction and operation traffic to access different areas of the project with limited impacts on Birriwa Bus Route South. This upgrade will enable access to the project for the purpose of constructing and operating the approved temporary accommodation facility, as well as the BESS. Oversize over mass vehicles will continue to access the project area via the approved primary access point (i.e. Castlereagh Highway-Barney's Reef Road-Birriwa Bus Route South).

- Increase the approved project's accommodation facility capacity from 500 workers to 650 workers, within the approved accommodation footprint (up to an additional 150 workers will reside at the accommodation facility in peak construction periods).

- Amend the schedule of land to include three additional neighbouring lots.

- Increase the total number of daily vehicle movements to and from the site during pre-construction and construction, from 120 to 156 daily heavy vehicle trips, split between the approved access via Barneys Reef Road and the proposed alternative access via Merotherie Road. Correction of wording errors in the consent conditions from "vehicle movements" to "vehicle trips".

The modification area is shown on Figure 1.2.

This LVIA report provides an assessment of the visual impacts associated with the proposed modification.

1.3 Visual elements of the modification

The assessment in this LVIA is confined to the main visual components of the modification, including:

- additional area for solar panels

- location of BESS. For the purposes of this LVIA, it has been assumed that the BESS will consist of shipping container style BESS units.

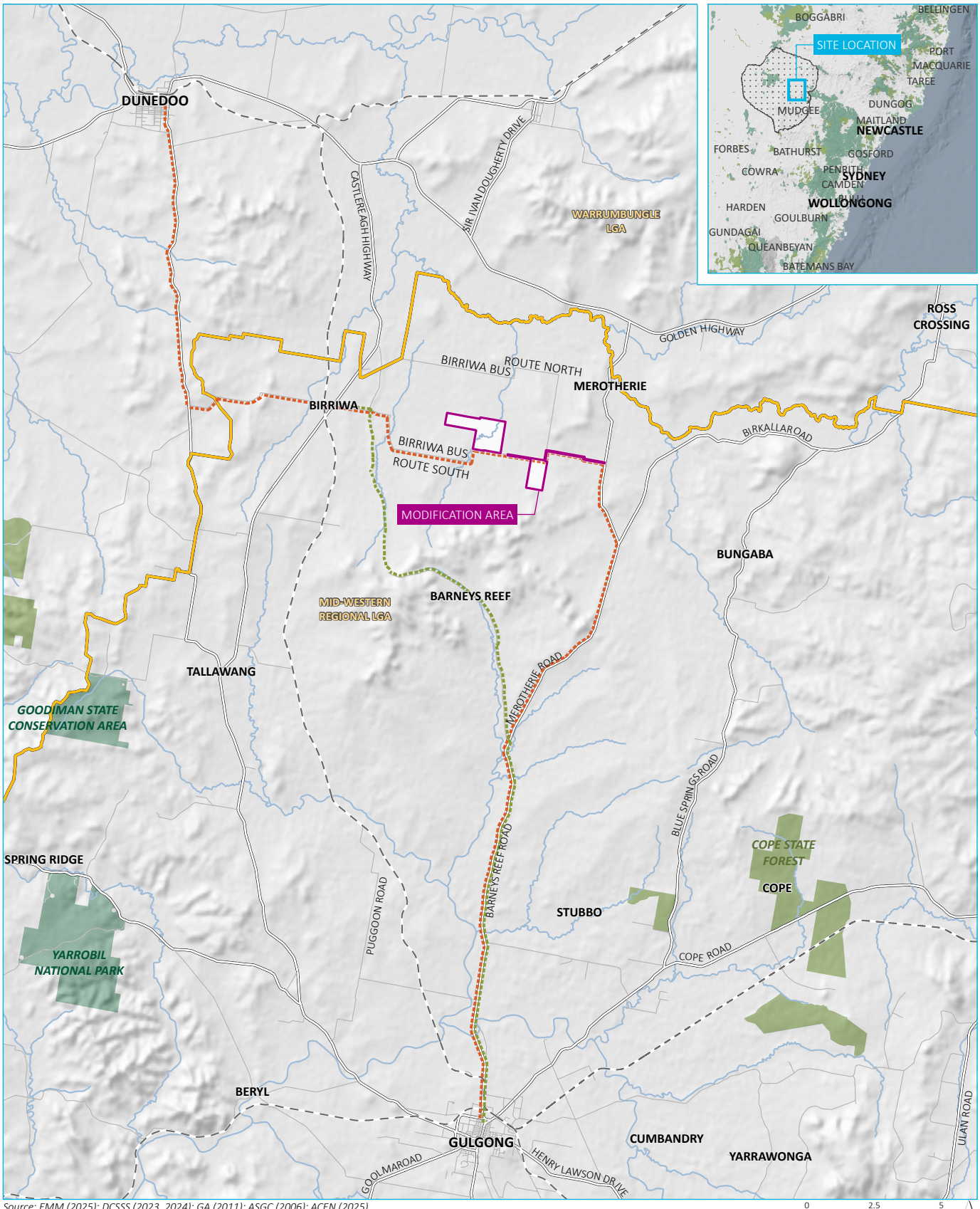
Because of the nature of the modification, any potential increase in visual impact compared to the approved project will be caused by potential:

- reduction in the distance between the viewer the visual elements
- increased horizontal visibility of the visual elements from a viewpoint
- increased vertical visibility of the visual elements. This may occur due to topography of the modification area and the relative height of receivers. Individual elements of the modification infrastructures (i.e. solar panels and BESS units) will be no higher than items proposed in the approved project.

The proposed modification will increase the extent of:

- the project area by approximately 257 hectares (ha) to 1792 ha (an increase of approximately 17%)
- the development footprint by approximately 224 ha to 1421 ha (an increase of approximately 19%).

Because of the modification's location and shape / size in relation to the approved project and site topography, visual impacts due to the modification are restricted to locations to the north-east of the modification area.



Source: EMM (2025); DCSSS (2023, 2024); GA (2011); ASGC (2006); ACEN (2025)

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GDA 1994 MGA Zone 55

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KEY

- Modification area

Existing environment

- Rail line
- Major road
- Minor road
- Watercourse
- Local government area
- Central West Orana Renewable Energy Zone (see inset)
- NPWS reserve
- State forest

Central West Cycle (CWC) Trail

- CWC main route- Gulgong to Dunedoo
- CWC alternate route- Slap Dash Creek side trail

Regional context

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 1.1

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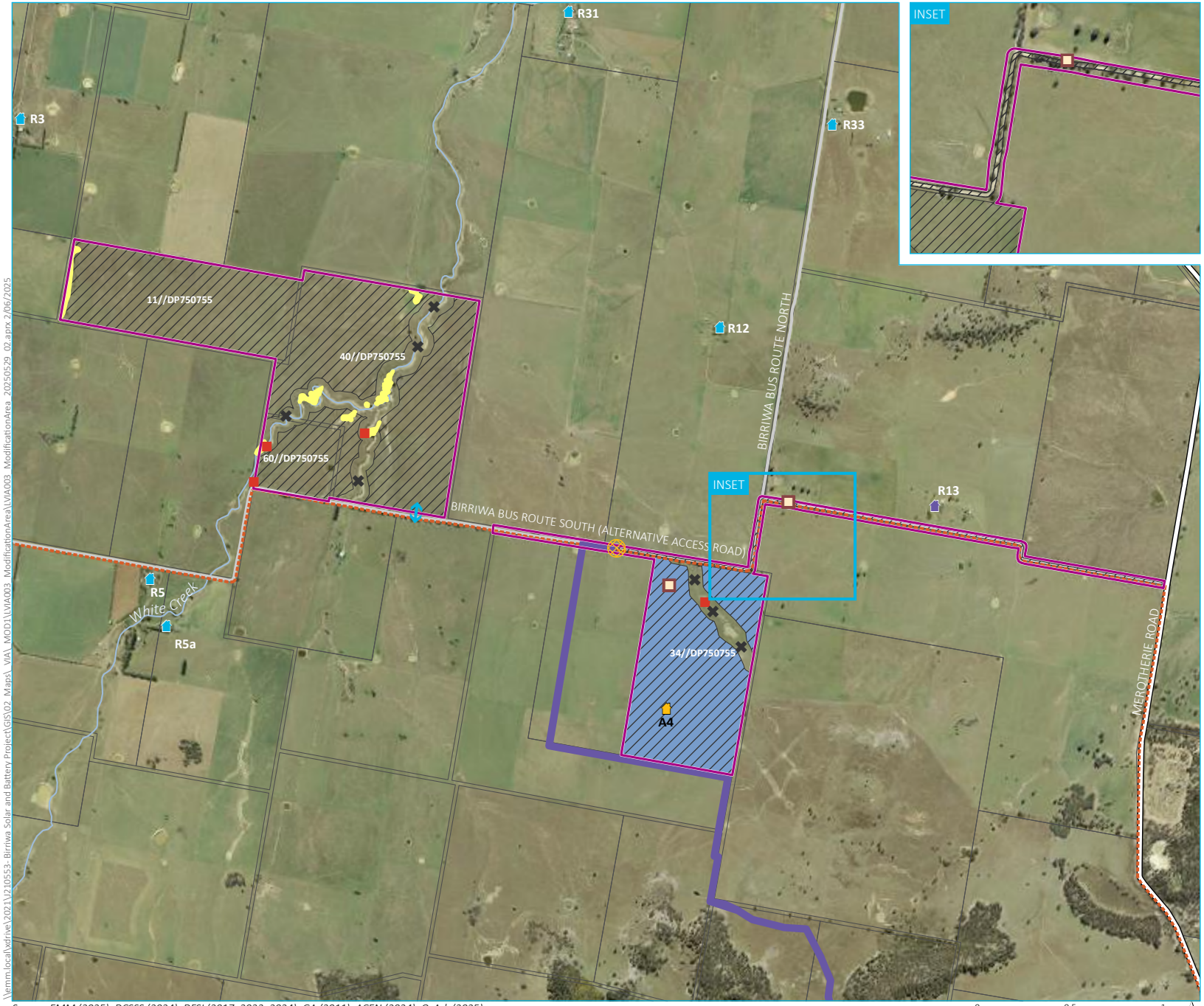
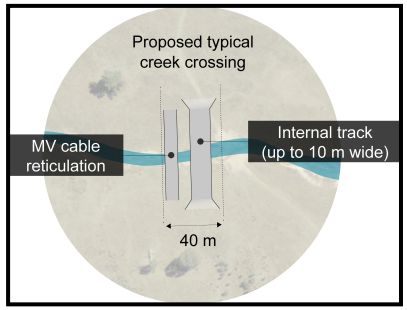


KEY

- Modification area
- Modification development footprint
- Vegetation to be retained
- Secondary access point
- Internal access track
- Proposed extension for operational infrastructure area including substation, operational facility and BESS
- Aboriginal heritage site (to be avoided)
- Aboriginal heritage site (to be salvaged/managed)
- Potential public road crossing location
- Potential creek crossing point (refer to inset below)

Existing environment

- Dwelling not associated with the project
- Dwelling associated with the project
- Dwelling not associated with the project (EnergyCo building)
- Major road
- Minor road
- Named watercourse
- Central West Cycle (CWC) Trail main route- Gulgong to Dunedoo
- Cadastral boundary



Modification area

Source: EMM (2025); DCSSS (2024); DFSI (2017, 2023, 2024); GA (2011); ACEN (2024); OzArk (2025)

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 1.2

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1.4 Assessment requirements and approach

The purpose of a LVIA is to provide a comprehensive assessment of a project's potential impacts on the character of the landscape and the impacts on the local visual amenity.

This LVIA was prepared with reference to the methods outlined in:

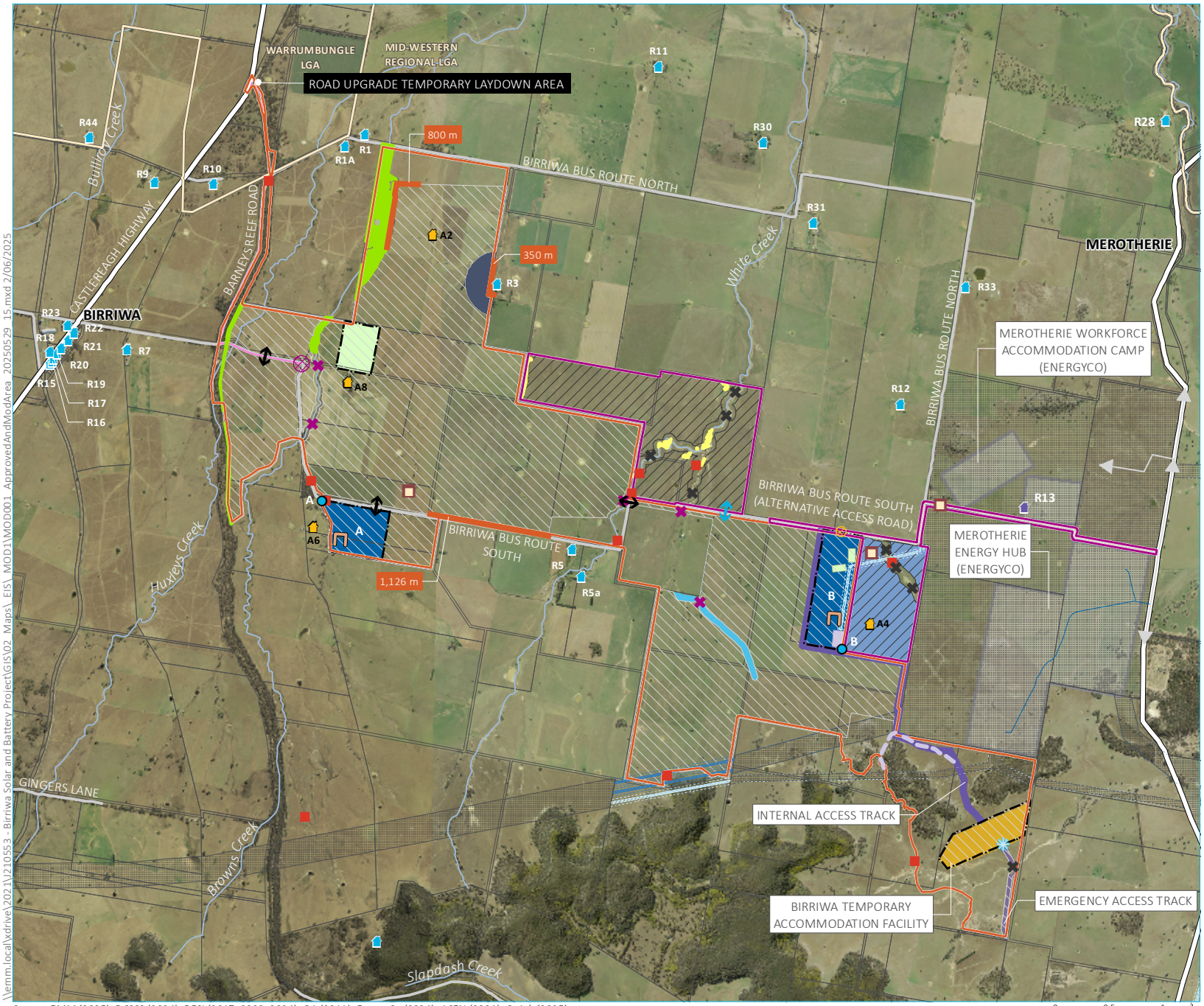
- *Large-Scale Solar Energy Guideline* (2024) (Solar Guideline), NSW Department of Planning, Housing and Infrastructure
- *Technical Supplement – Landscape and Visual Impact Assessment* (2024) (Technical Supplement), NSW Department of Planning, Housing and Infrastructure.

Updated versions of the Solar Guideline and Technical Supplement were released by DPHI in November 2024 and provide the community, industry, applicants and regulators with guidance on the planning framework for the assessment and approval of large-scale solar energy development proposals under the EP&A Act, which are classified as State significant development (SSD). The Solar Guideline outlines a visual assessment framework for large scale solar energy development. The acceptability of visual impacts, namely impacts on landscape character and values and the amenity of landholders and communities, along with the adequacy of the measures that are proposed to avoid, reduce or otherwise manage these impacts, are identified as key assessment issues within the guideline and have been considered within this LVIA.

This LVIA also references techniques and methods outlined in the following publications:

- *Guidelines for Landscape and Visual Impact Assessment Third Edition* (2013) (the GLVIA), Landscape Institute and Institute of Environmental Management and Assessment
- *The Dark Sky Planning Guideline* (2016), NSW Department of Planning and Environment.

The project is approximately 100 kilometres (km) south-south-east of Siding Spring Observatory. Therefore, *The Dark Sky Planning Guideline* is applicable to this LVIA.



KEY

Approved project layout

- Project area
- Development footprint
- Restricted development area
- Road upgrade corridor
- Vegetation to be retained
- Potential creek crossing point
- Potential public road crossing location
- Connection point (option A or B)
- Indicative noise wall location
- Solar panel setback
- Landscape screen planting
- Project access point
- Emergency access point
- Operational infrastructure area including substation, operational facility and BESS (Option A or B)
- Birriwa temporary accommodation facility
- Temporary construction compound

Modification project layout

- Modification area
- Modification development footprint
- Vegetation to be retained
- Secondary access point
- Internal access track
- Potential creek crossing point
- Potential public road crossing location
- Proposed extension for operational infrastructure area including substation, operational facility and BESS

EnergyCo infrastructure

- 500 kV transmission line
- 330 kV transmission line
- Permanent access easement
- Access in/out
- Access road
- Brake and winch site
- 330 kV switching station
- Indicative construction easement (adjacent property)
- Merotherie Energy Hub and workforce accommodation camp

Existing environment

- Dwelling not associated with the project
- Dwelling not associated with the project (EnergyCo building)
- Dwelling associated with the project
- Aboriginal heritage site (to be avoided)
- Aboriginal heritage site (to be salvaged/managed)
- Local government area boundary
- Major road
- Minor road

The approved project and the modification area

Source: EMM (2025); DCSSS (2024); DFSI (2017, 2023, 2024); GA (2011); EnergyCo (2024); ACEN (2024); OzArk (2025)

0 0.5 1 km

GDA 1994 MGA Zone 55

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Birriwa Solar and BESS Project - Modification
Figure 1.3

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2 Methodology

2.1 Introduction

The assessment method used in this LVIA adheres to the Solar Guideline requirements. There are three main elements that make up the LVIA. The first involves establishment of the visual study area and other assessment boundaries, followed by identification of viewpoints for further assessment.

The second element of the LVIA is a landscape character assessment. This details the current condition of the landscape and assesses its capacity to absorb change. The final element is the visual impact assessment, which provides a detailed assessment of the impact of the modification on the visual amenity of the area. The methodology used for all three elements is described in Annexure A.

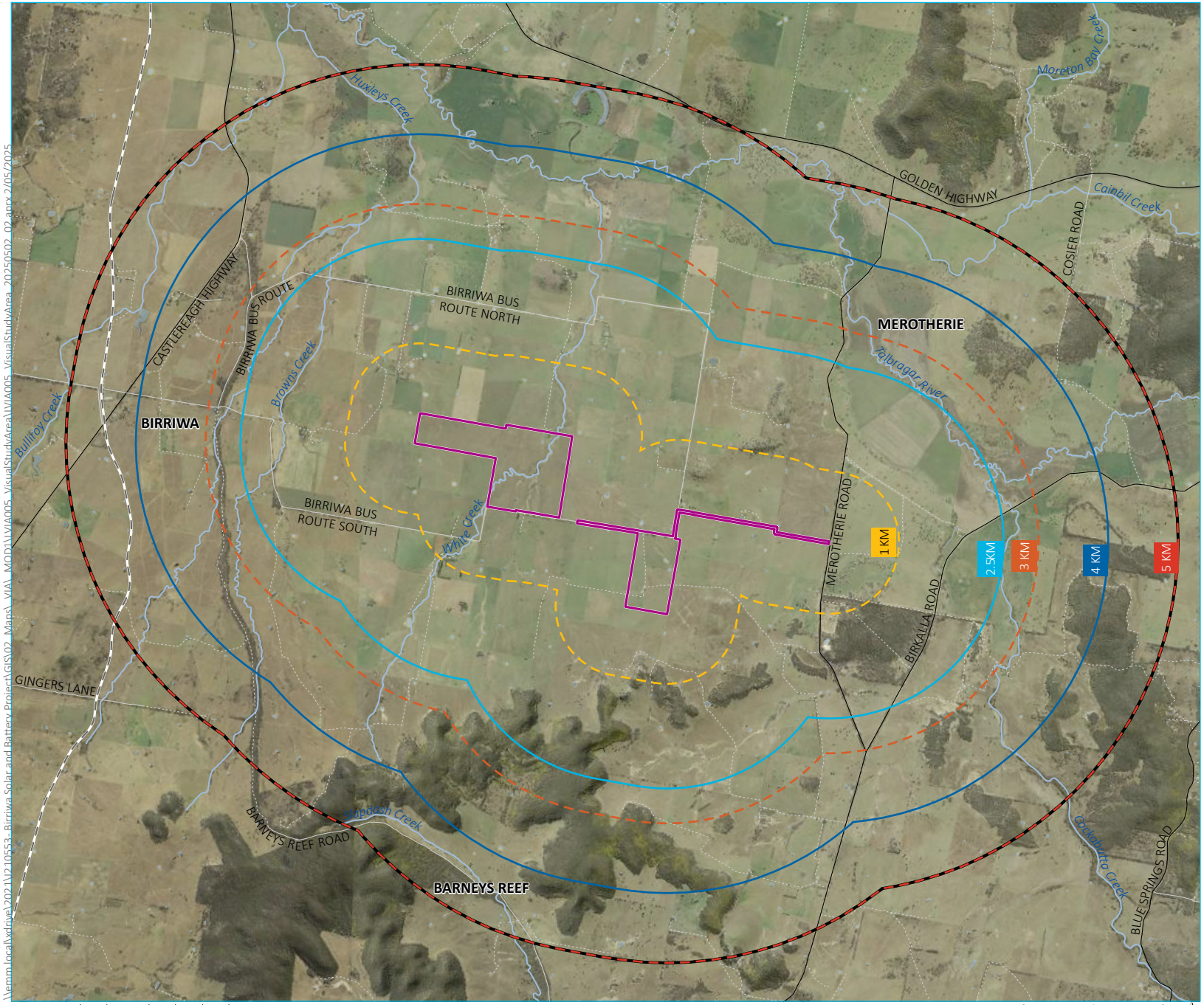
2.2 Visual study area and assessment boundaries

The visual study area for this LVIA extends to 4 km from the modification area. All private receivers within the visual study area are required to be assessed, and all public viewpoints within 2.5 km of the modification area are required to be assessed.

Other assessment boundaries required by the Solar Guidelines and/or the Technical Supplement include:

- the landscape character assessment boundary which extends to 5 km as described in Section 4
- the glint and glare assessment applies to:
    - residential receivers – up to 3 km from the source
    - roads and rail lines – up to 1 km from the source
    - aviation receivers – up to 5 km from the source.

The visual study area and other assessment boundaries are shown on Figure 2.1.



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Source: EMM (2025); DCSSS (2024); GA (2009)

Visual study area and assessment boundaries

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 2.1

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3 Visual baseline study

3.1 Land use

The visual study area is located in a rural setting. Key land uses in the local and broader region include agriculture, consisting primarily of sheep and cattle grazing and dry land cropping, with areas of mining, viticulture and production forestry within the broader region (in the vicinity of Gulgong and Mudgee). There are 16 dwellings scattered within 4 km of the modification (Figure 2.1).

The majority of the land comprising the visual study area is zoned RU1 primary production under the *Mid-Western Regional LEP 2012*.

3.1.1 Historic heritage

An historic heritage assessment (HHA) for the Birriwa solar and battery project was completed in 2022 (OzArk 2022 B). An addendum HHA (Ozark 2023) was completed addressing the modification area in 2023. A third HHA (Ozark 2025 B) was completed for the modification area in 2025. This latest report found no items of historic heritage significance under current Heritage NSW guidelines or under the Burra Charter within the modification area.

3.1.2 Aboriginal heritage

An Aboriginal cultural heritage assessment (ACHA) for this project was completed in 2022 (OzArk 2022 A). An addendum ACHA (Ozark 2023) was completed addressing the accommodation facility study area in 2023 and an ACHA for the modification area was completed in 2025 (Ozark 2025 A).

The ACHA report for the modification area found that six Aboriginal sites are in the modification area, with two that may be impacted by the modification. The report made recommendations regarding mitigation measures these sites.

3.2 Residences

A number of non-associated and associated residences have been identified in the vicinity of the modification area. Associated residences whose owners have a landholder agreement with ACEN for the project are identified with an ‘A’. Non-associated residences are not associated with the project and do not hold landholder agreements with ACEN and are identified with an ‘R’.

There are a total of 16 non-associated residences within 4 km of the modification area. The locations of the receptors considered as part of this assessment are shown on Figure 6.1.

3.3 Roads and rail

The main transport infrastructure is made up of the Castlereagh Highway (B55) and the Golden Highway (B84). Castlereagh Highway runs north-south approximately 3.5 km west of the modification area at the closest point. The Golden Highway runs east-west approximately 4 km north of the modification area.

There is a rail line connecting Birriwa to Dunedoo to the north and Gulgong to the south. The closest point the rail is to the modification is approximately 4 km to the west.

Access to the project is off Castlereagh Highway via Birriwa Bus Route South or Barneys Reef Road. Both of these connect to Castlereagh Highway just north of Birriwa village.

Photograph 3.1 Birriwa Bus Route North

3.4 Towns

Townships in the region of the modification are characterised by scattered small villages and small rural centres.

The closest township to the modification is Birriwa – a small village of less than 50 people (according to 2021 census data) located near the northern border of the Mid-Western Regional LGA. Birriwa lies just over 4 km to the west of the modification area.

The nearest larger towns are Dunedoo (population approximately 700 in 2021 census), located 22 km north-west of the modification area, and Gulgong (population 2,600 in 2021 census), located 22 km south of the modification area.

3.5 Vegetation

Much of the modification area has been extensively cleared of trees and has been highly modified by historic farming practices.

The landscape typical of the region is predominantly cleared, open grazing land with scattered groupings of remnant native trees. Existing vegetation is generally found along drainage lines, roadsides and along the perimeter of paddocks and property boundaries.

The remnant vegetation in or near the modification area is derived from the following vegetation communities:

- Yellow Box grassy woodland on lower slopes and valley flats within/around the study area
- Rough-Barked Apple – Red Gum – Yellow Box woodland along the lower northern slopes of Barneys Reef

- Queensland Bluegrass – Redleg Grass – Rats Tail Grass – Spear Grass – Panic Grass derived grassland along the lower slopes of Barneys Reef.

3.6 Topography

Most of the project falls from the lower slopes of Barneys Reef, which runs east to west along the southern boundary of the project. The elevation falls from 500 m above mean sea level (AMSL) to approximately 420 m AMSL at the north-western corner of the project. The modification area lies close to the lower, northern part of the project area. There are waterways running through the project from south to north toward the Talbragar River. These waterways have shaped the landscape creating low undulating hills and valleys across the landscape.

Photograph 3.2 Typical landscape character

3.7 Landscape values

Mid-Western Regional Council has identified enhancing and protecting the region's biodiversity and natural heritage as a key planning priority in their *Strategic Planning Statement* (2020). This would indicate there is a high value placed on the natural landscape. Elements like waterways that support vegetation and wildlife would have a high community value. This would be true of wooded areas like Barneys Reef as well.

No significant scenic vistas have been identified as having potential to be impacted by the modification.

3.8 Other developments

The following developments have been identified in various stages of planning, which are in close proximity to the modification:

- ACEN is seeking approval to develop the Valley of the Winds project, which is located north of the Golden Highway. The closest turbine is 10 km north of the modification area, between Leadville and Uarbry. The project stretches northward to Coolah. This project is not expected to be visible from the modification area.

- Narragamba Solar project is in the environmental impact statement (EIS) preparation stage of the approvals process. It is located approximately 4 km south-east of the modification area. There is a very low chance of any cumulative impact anticipated due to low visibility of the modification area from Merotherie Road.

3.9 Key landscape features

Key features in the landscape add to the character and uniqueness of a place. The features may include dramatic natural features like a mountain peak, cliff or waterfall. A feature can also be much smaller in scale like a distinctive tree or cluster of trees that stands out visually in the landscape.

The features identified below help define the project area and its surrounds and thus are key elements in the landscape.

3.9.1 Barneys Reef

The reef is a distinct feature characterised by steep rocky slopes that define the valleys around it. The upper slopes are covered with remnant vegetation that contrasts with the agricultural land along the valleys.

3.9.2 Agricultural valleys

The valleys are defined as alluvial plains along waterways. They have flat or gently undulating land that rises from a river or creek. The land has been cleared to make way for agricultural uses, including cropping and grazing.

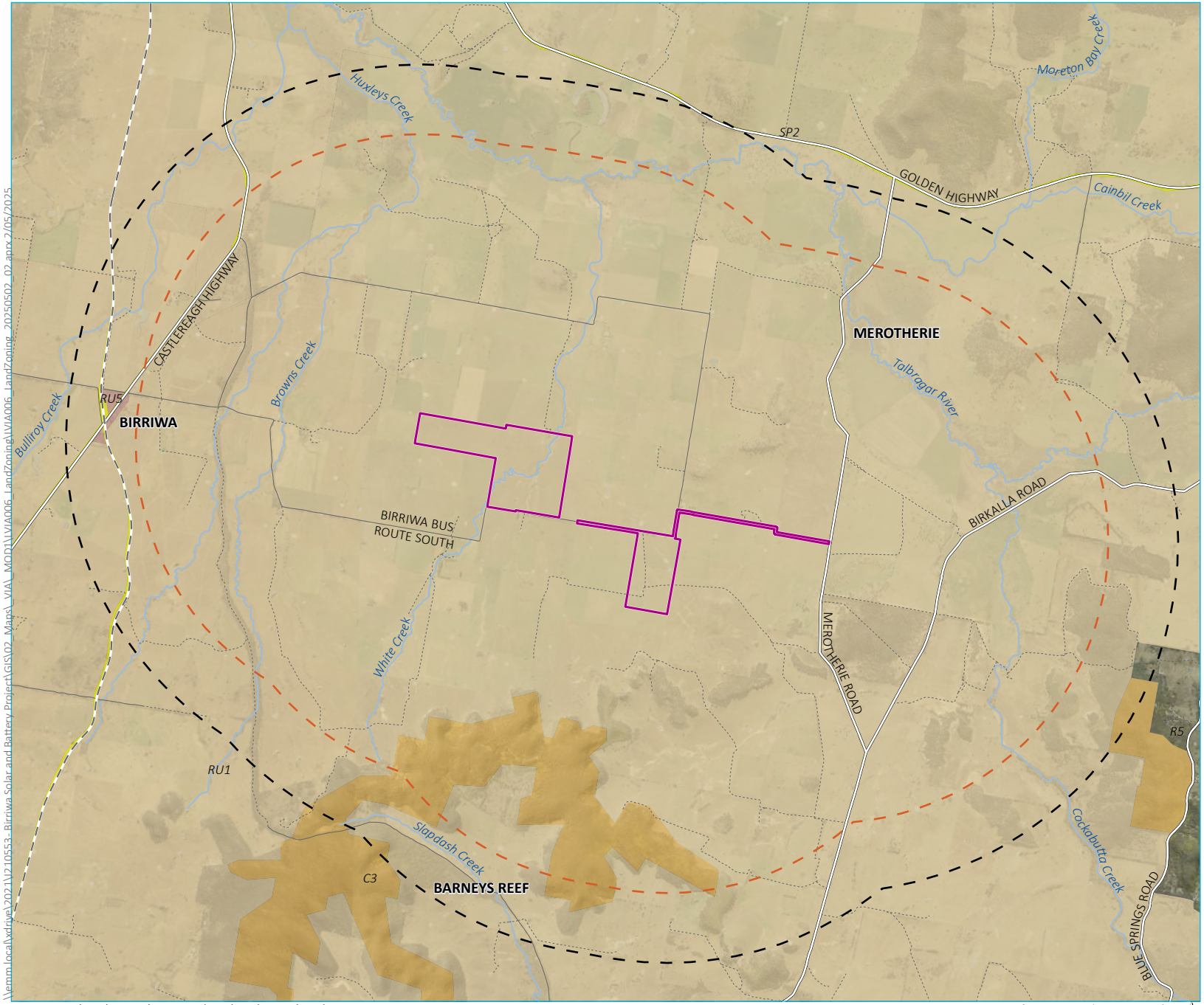
3.10 Land zoning designations

In NSW, land zones are used to determine the range of permissible or prohibited land uses on a parcel of land. Land zones can have a significant impact on a location's visual character by determining the type and size of development that can occur, the types of structures that can be built, and the type of vegetation that may occur in an area.

The modification is entirely located in the Mid-Western Regional LGA, approximately 4 km east of the town of Birriwa. Table 3.1 lists the land use zones in the visual study area Figure 3.1 shows their location.

Table 3.1 Land use zoning

Zoning surrounding the project	Objectives relevant to landscape and visual impacts
RU1 Primary Production	• To encourage sustainable primary industry production by maintaining and enhancing the natural resource base. • To encourage diversity in primary industry enterprises and systems appropriate for the area. • To minimise the fragmentation and alienation of resource lands. • To minimise conflict between land uses within this zone and land uses within adjoining zones. • To maintain the visual amenity and landscape quality of Mid-Western Regional by preserving the area's open rural landscapes and environmental and cultural heritage values. • To promote the unique rural character of Mid-Western Regional and facilitate a variety of tourist land uses.
C3 Environmental Management	• To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values. • To provide for a limited range of development that does not have an adverse effect on those values. • To manage development within the water supply catchment lands of Windamere and Burrendong Dams, to conserve and enhance the district's water resources.



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Source: EMM (2025); DCSSS (2023, 2024); GA (2011); ACEN (2022)

Land use zoning

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 3.1

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3.11 Airfields

There are two airfields that may be affected by the project. These are the Dunedoo airfield and the Dunedoo hospital helipad.

- The Dunedoo airfield (YDNO) is located 9.3 km north-west of the project site. The flight path for the airstrip appears to be southwest to north-east. Therefore, aircraft are not flying over the solar arrays nor are they forced to fly within close proximity to the project as they approach for landing. There is little potential for impacts on aircraft from reflection or glare from the solar arrays.

- The Dunedoo hospital helipad (YXDN) is located 14.2 km north-west of the project site. Helicopters approaching and leaving the helipad are not forced to fly above or near the solar arrays and therefore should not be affected by reflection or glare from the solar arrays.

Both facilities are outside the minimum 5 km distance requiring assessment for glint and glare under the Solar Guideline.

4 Landscape character assessment

Landscape character assessment helps applicants and the community to understand the "sensitivities of a landscape and determine the impact of a project on an area's character and sense of place" (Technical Supplement, p. 15). The landscape character assessment boundary for this LVIA has been set at 5 km as required by the Technical Supplement.

4.1 Landscape character zones

The landscape surrounding the project area has been categorised into two Landscape character zones (LCZ). These are based on the dominant landform and landscape features that create distinct character areas.

For this report, the LCZ areas have been defined as:

- agricultural plains
- forested ridges.

A typical arrangement of both LCZ's is shown in Photograph 4.1 below, and each LCZ is described in the following sections. A map of the LCZ's is provide in Figure 4.1.

Photograph 4.1 Agricultural plains with forested ridge in the background

4.1.1 Agricultural plains

The agricultural plains LCZ is defined by landscape that has been highly modified from its natural state. The land within and surrounding the modification area has been extensively cleared to make way for agricultural and farming uses that include dryland cropping and grazing.

The main body of water, White Creek, winds through the modification area flowing in a northerly direction, with a higher concentration of trees associated with the waterway as the creek winds through before joining the Talbragar River.

Views from this LCZ are dominated by open grasslands, cropping and grazing land with rolling wooded hillsides. The topography of this land in the area is varied with undulating grazing and agricultural land and scattered vegetation, with wooded ridgelines (of the forested ridge LCZ described in Section 5.2) in the distant background.

There have been a number of modifications within this landscape, including rural farm buildings that have been erected. Powers lines, fences, unsealed rural roads and farmland are all apparent in views of this LCZ.

Photograph 4.2 Agricultural plains landscape character with typical unsealed road and fence line in the foreground

4.1.2 Forested ridges

The forested ridge LCZ is defined by a wooded landscape atop hills that sit above the surrounding cleared paddocks and agricultural land. It is located in areas that are not suited to agriculture and therefore occurs along ridges and rocky areas, particularly on Barneys Reef.

The forested ridge LCZ does not occur within the development footprint but is visible from within the modification area.

Photograph 4.3 Forested ridge landscape character beyond agricultural foreground

4.2 Landscape character assessment

Independent of the approved project, the modification has been assessed as having at most a moderate impact on landscape character. When considered in association with the approved project, the additional landscape character impact of the modification will be insignificant. Table 4.1 summarises the landscape character assessment.

Table 4.1 Landscape character assessment

Landscape character zone	Sensitivity	Magnitude	Landscape character impact
Agricultural plains	**Low** • The landscape is highly modified with clearing of native vegetation and presence of cropping, agricultural structures, fencing, dwellings, and roadways. As such, it is considered to have some capacity to absorb the type of change envisaged. • The landscape elements that contribute to its quality will remain the same. • The project is not predicted to impact any key landscape features.	**Low** • Views of the project are likely to be limited by the topography and trees surrounding the Project. • The project infrastructure will have an evident change in the landscape from close range. However, the extent of this change is considered minor in relation to the extent of this LCZ. • When viewed from afar, the project is not expected to compete visually with the landform and vegetation of this LCZ.	**Low**
Forested ridge	**Moderate** • The areas in this LCZ are visible from a distance and form a key element of the visual catchment. Any changes to the bushland is expected to be visible from the surrounding landscape. • The landscape elements that contribute to its quality will remain the same. • The project is not predicted to impact any key landscape features.	**Low** • The project will not occupy any portion of this LCZ. • The project elements may be visible from some locations within this LCZ, however, access to most of the areas in this LCZ is restricted and views into the development footprint are limited.	**Moderate-Low**

Source: EMM (2025); DCSSS (2023, 2024); GA (2011); ACEN (2022)

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Landscape character zones

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 4.1

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5 Viewshed mapping

5.1 Introduction

Viewshed mapping is a method of mapping the theoretical visibility of a project across the surrounding landscape and is used to identify locations with potential views to project infrastructure. Using geographic information systems (GIS) technology, the topography of the land is combined with project infrastructure modelling to analyse the potential visibility of the project. The results are the zone of visual influence (ZVI).

The ZVI diagram is generated using a digital elevation model (DEM) that covers the visual study area. The DEM is built using publicly available ELVIS spatial data from the Foundation Spatial Data Framework. The DEM is representative of the bare earth surface and only considers the topography of the landscape. In accordance with the Technical Supplement, the screening potential of vegetation and built structures is not considered in the mapping. This is important for viewpoints which are identified as having visibility of the project in this LVIA but may in fact have no or obstructed views towards project infrastructure due to intervening vegetation or buildings. As such, the ZVI only show where landforms obstruct views and represents a worst-case scenario in terms of project visibility.

The ZVI assists in determining where potential visual impacts will occur, and to what extent. The ZVI for the modification is presented in Figure 5.1. The following should be noted:

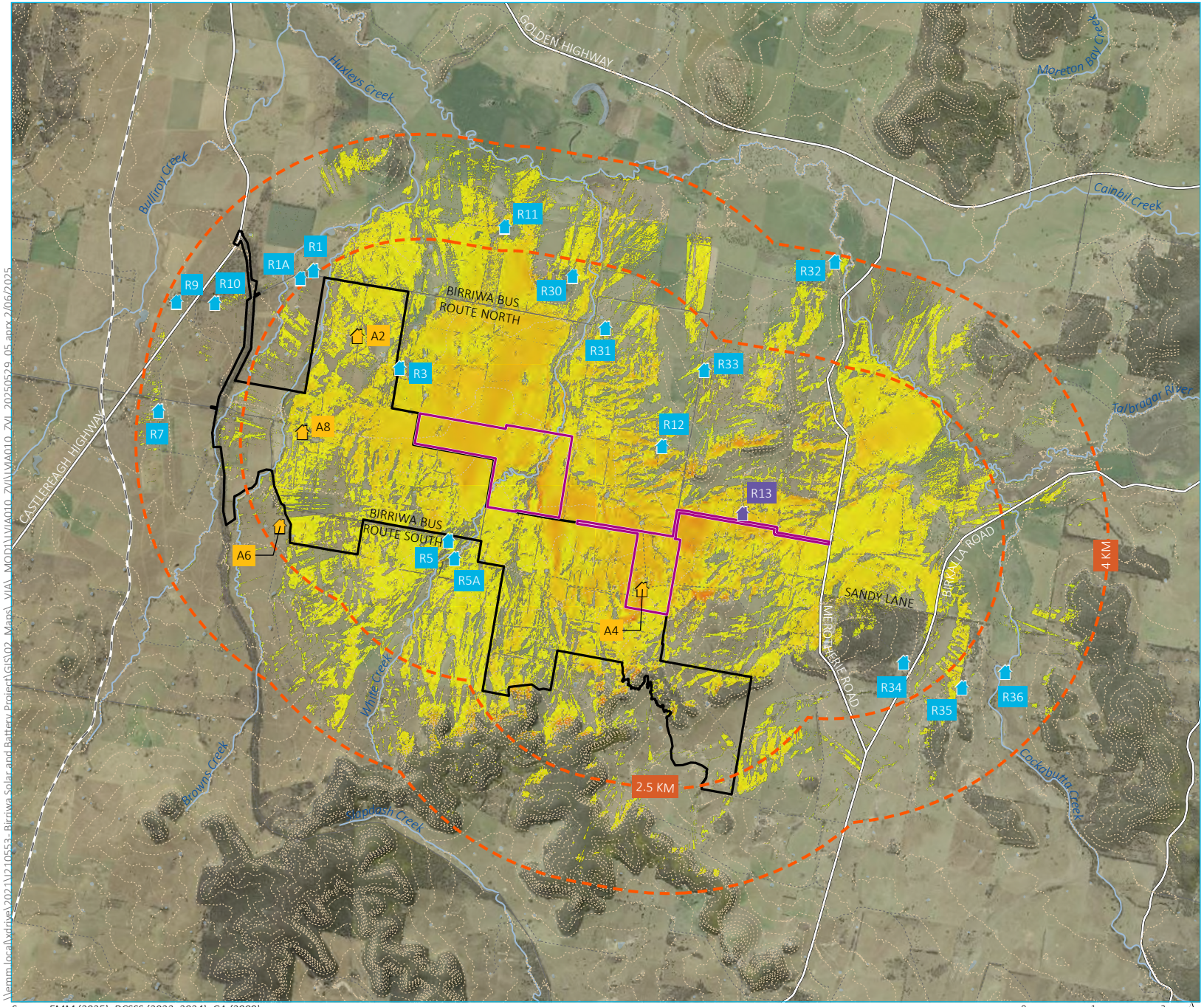
- The ZVI covers the visual study area, up to 4 km from the modification area as required by the Technical Supplement.
- The ZVI does not account for the diminishing size of project infrastructure as the viewer moves further away and only indicates where project infrastructure will be visible.
- The ZVI figure uses coloured shading to indicate how much of the project may be visible from a particular location. Yellow shading indicates potential partial views of the project, with orange to red shading indicating visibility of an increasing proportion of the project infrastructure from a particular vantage point. The shading does not indicate specifically how many solar panels or which part of the project is visible from a particular location. Unshaded locations are not predicted to have any views of the project components.

5.2 Summary of ZVI

The ZVI presented in Figure 5.1 indicates the following:

- The gently undulating topography of the visual study area limits views beyond approximately 2.5 km from the modification area.
- Locations with potential visibility of the project are shown almost entirely by yellow shading, indicating only partial visibility for almost any vantage point. The lack of dark orange / red shading indicates the full extent of the modification infrastructure would not be visible from any receptor location.
- Road users along Birriwa Bus Route South are likely to have views as the road runs along the project boundaries.
- Vegetated water corridors within and around the project along with localised topographical variations may assist in containing or reducing views of the modification infrastructure.

It should be noted that the modification infrastructure will represent a small increase in the size of the project, and for viewpoints to the west or south of the project any visibility of modification infrastructure will be significantly mitigated by the screening effect of approved project infrastructure.



Source: EMM (2025); DCSSS (2023, 2024); GA (2009)

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Zone of visual influence

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 5.1

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6 Viewpoint selection

6.1 Introduction

To assess these impacts, specific viewpoints are used to represent what people can see from that location and its immediate surrounds. A viewpoint might be selected at a dwelling, or near a cluster of dwellings to illustrate the visibility of a project from those dwellings. Viewpoints can also be along roadways and at public locations to capture the visual experience people have while in those places.

Viewpoints for this LVIA have been selected based on the following criteria:

- Private receivers within the visual study area that have a potential view of the modification based on the ZVI
- Public viewpoints within 2.5 km of the modification area that have a potential view of the modification based on the ZVI.

Details of selected viewpoints are provided in the following sections. Locations of the viewpoints considered as part of this assessment are illustrated on Figure 6.1.

Site inspections were carried out during early 2022 as part of the preparation of the LVIA for the EIS, and again in 2023. The purpose of the site inspections was to ground-truth the viewpoints identified during the initial desktop analysis and photograph the project area from the viewpoints.

Site visits over last 12 months and review of recent aerial photography have confirmed no significant changes to the visual environment that would impact this assessment.

6.2 Private receivers

There are 17 non-associated private residences and one non-associated building (R13) in the visual study area as listed in Table 6.1. The ZVI (Figure 5.1) indicates potential visibility based on topography of the modification infrastructure at nine of these residences. Potential visual impacts at these residences are assessed in Chapter 7.

Four of these private viewpoints have been selected for detailed assessment, as described in Table 6.1, with photomontages prepared and included in Annexure B. It is also noted that the distance provided in Table 6.1 for each receiver is the distance to the closest point of the modification area. The distance to the BESS at location option B (where an increase in capacity is proposed) is also provided for those receptors nearest to this part of the modification area (i.e. R13, R34, 35, and 36).

Table 6.1 Private receivers in the visual study area

Receiver	Potential view in ZVI	Distance to modification area (m)	Notes	Further assessment required
R1	No	2,540	The ZVI indicates no visual impact from this location.	No
R1A	No	2,580	The ZVI indicates no visual impact from this location.	No
R3	Yes	710	Assessed in Annexure B.	Yes
R5	Yes	740	Assessed in Annexure B.	Yes
R5a	Yes	740	This residence is located at a lower elevation than R5 and would have similar views. Any visual impacts will be similar or lower than R5.	No
R7	Yes	3,718	The ZVI indicates no visual impact from this location.	No

Receiver	Potential view in ZVI	Distance to modification area (m)	Notes	Further assessment required
R9	No	3,835	The ZVI indicates no visual impact from this location.	No
R10	No	3,310	The ZVI indicates no visual impact from this location.	No
R11	Yes	2,930	This residence is at a bearing between R3, R31 and R12, and at a considerably greater distance. Any impact will be less than that assessed for these three locations.	No
R12	Yes	1,240	Assessed in Annexure B.	Yes
R13	Yes	110 (970 to BESS at location option B)	This location has not been assessed because it is a building used for the purpose of construction activities associated with the neighbouring CWO REZ Transmission Project, and is not a private residence.	No
R30	Yes	2,150	This residence is at a similar bearing to R31 and at a greater distance. Any impact will be less than that assessed for R31.	No
R31	Yes	1,600	Assessed in Annexure B.	Yes
R32	Yes	4,490	This residence is at a similar bearing to R12 and R31 and at a greater distance. Any impact will be less than that assessed for R12.	No
R33	Yes	2,150	This residence is at a similar bearing to R12 and at a greater distance. Any impact will be less than that assessed for R12.	No
R34	No	2,010 (3,450 to BESS at location option B)	The ZVI indicates no visual impact from this location.	No
R35	No	2,700 (4,300 to BESS at location option B)	The ZVI indicates no visual impact from this location.	No
R36	No	3,100 (4,900 to BESS at location option B)	The ZVI indicates no visual impact from this location.	No

6.3 Public viewpoints

The only public viewpoints in the visual study area are the public roads within 2.5 km of the modification area. These roads are listed in Table 6.2. Four public viewpoints (one on each road) have been selected for assessment of potential typical visual impacts on these roads. Locations of these public viewpoints are shown on Figure 6.1.

Table 6.2 Public viewpoints

Viewpoint	Road name	Description	ZVI indicates potential visibility	Further assessment required
PVP-01	Birriwa Bus Route North	Unsealed local road.	Yes	Yes
PVP-02	Birriwa Bus Routh South	Unsealed local road.	Yes	Yes
PVP-03	Merotherie Road	Unsealed local road.	Yes	Yes
PVP-04	Birkalla Road	Unsealed local road.	Yes	Yes

6.4 Viewpoints selected for detailed assessment

From the private receivers and public viewpoints identified above four have been selected for detailed assessment with photomontages. These four are predicted to experience typical visual impacts.

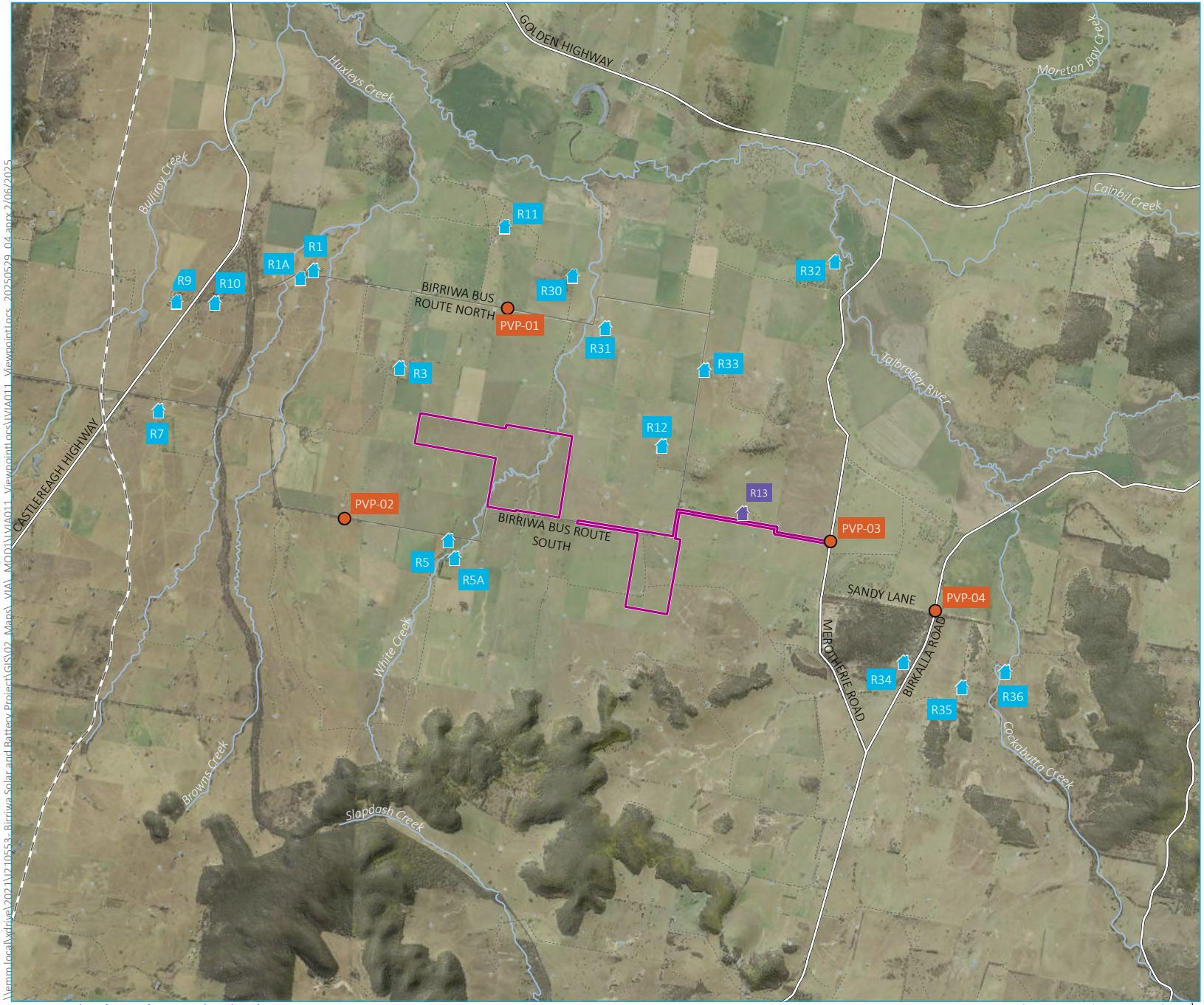
Table 6.3 provides the rationale for selecting each viewpoint location. The viewpoints were selected based on the following criteria:

- proximity to project elements
- level of visibility indicated by the ZVI
- the location of dwellings and other local features and important sites
- the positioning of regional and local roads and potential impacts on passing motorists
- local topography
- presence of remnant vegetation and wind breaks with potential to provide screening.

Photographs from these selected viewpoints were captured and a selection of these photographs has been provided in Annexure B as part of the viewpoint analysis. The photographs are used to represent and assess the visual changes that may occur from the development of the modification.

Table 6.3 Selected receivers and rationale for selection

Receiver	Distance to modification area (m)	Rationale for selection
R3	710	This viewpoint is one of the closest to the modification area and represents views from the west of the modification area. This location has a similar view of the modification PVP-01.
R5	740	This viewpoint is located on Birriwa Bus Route South, south of the solar panels associated with the modification and west of the proposed BESS. However, it is noted that this part of Birriwa Bus Route South is not proposed to be upgraded by the modification. Views for R5a would be similar but at a lower elevation from this location. This viewpoint is also indicative of views from PVP-02 and of views experienced by cyclists on the Central West Cycle Trail, which runs along Birriwa Bus Route South.
R12	1,240	This viewpoint is the closest to the modification area to the north-east of the additional lots proposed for solar panels, and represents views from the east of this part of the modification area, as well as views north of BESS location option B.
R31	1,600	This viewpoint is the closest to the modification area to the north of the additional lots proposed for solar panels, and represents views from the north of the modification area. Views for R11 and R30 would be similar but more distant than views from this location.



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Source: EMM (2025); DCSSS (2023, 2024); GA (2009)

Viewpoint locations and receptors

Birriwa Solar Farm Modification
Visual Impact Assessment
Figure 6.1

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7 Visual impact – viewpoints

7.1 Visual impacts during construction

Apart from provision of an additional access, the modification does not propose any changes to construction methodology that is part of the approved project. These impacts are considered temporary with the construction period estimated to be approximately 28 months for the entire project, including the modification. The main temporary visual impacts connected to the modification will be a slight increase in the area over which construction activity will be visible.

Additional traffic generated by the alternative access will be visible from some private receivers, including R12 which will have partial views of the part of Birriwa Bus Route South that will be upgraded.

No visual impacts caused by construction of the modification are anticipated to be significant. No mitigation measures are required for visual impacts caused by construction of the modification.

7.2 Visual impacts during operation

The visual impacts during operation are those visual impacts that occur after the construction phase of the project throughout its operational life. Visual impacts from operation of the modification will be caused mainly by:

- extension of area of solar panels
- location of the BESS
- infrequent and limited vehicle and traffic movements for maintenance activities.

Table 7.1 and Annexure B contain the visual impact analysis from each of the assessed viewpoints with assessment ratings based on the methodology outlined in Chapter 2 and described in detail in Annexure A. The ratings in the viewpoint assessments are based on the visual impacts from the operational phase of the project.

Photographs from four selected viewpoints were captured and have been provided as part of the viewpoint analysis. The photographs are used to represent and examine the human experience of the visual changes that may occur from the project.

For each of the four selected viewpoints, the following have been prepared:

- Panoramic photograph showing the current view with a horizontal field of view of 180°.
- Photomontages showing the visual impact of the operational elements of the modification and of the approved project.
- Photomontages with a grid overlay for assessing the magnitude of any visual impact.

7.2.1 Private viewpoints

Visual impacts for all private receivers in the visual study area have been assessed and are shown in Table 7.1. It is noted that the viewpoint at R13 has not been assessed because it is a building used for the purpose of construction activities associated with the neighbouring CWO REZ Transmission Project and is not a private receiver.

The following general points can be made about all assessed viewpoints:

- All viewpoints have been assessed as secondary views from dwellings in rural zones. Photographs for all private receivers were taken from locations near the dwelling to ensure a worst-case view of the modification infrastructure was obtained for the photomontages. In all cases views from the house will be significantly less impacted than shown in the photomontages.
- Scenic quality for all viewpoints was rated as low, reflecting their location in mostly flat or undulating terrain that is predominantly cleared for agricultural purposes.

Based on this assessment and on analysis of site and project data, the following points can be made:

- Development in the modification area may reduce the distance between some receivers and the project's infrastructure. This effect would be greatest for R12, however the visual impact rating for R12 remains low.
- For one non-associated residence, R3, the modification may result in a small increase in the horizontal angle occupied by the project. Any increase in visual impact as a result of this increase will be minor in comparison to the approved project. The visual impact rating for R3 remains very low.
- The photomontages for R3 and R31 indicate the small scale of the modification in comparison to the approved project.

7.2.2 Public viewpoints

The only public viewpoints within the visual study area are for motorists and cyclists within 2.5 km of the modification infrastructure. These areas are shown on Figure 2.1 and include parts of:

- Birriwa Bus Route South
- Birriwa Bus Route North
- Merotherie Road
- Birkalla Road.

The ZVI (Figure 5.1) indicates potential visibility for some locations on all these routes. Results of viewpoint analysis for these roads are shown in Table 7.1.

Visual impacts from these locations are not considered significant because:

- the ZVI indicates potential partial visibility of the modification infrastructure based on topography from most locations on these routes
- from most locations views of the modification infrastructure that are not screened by topography will be screened by either:
    - existing roadside vegetation and structures. The extent of roadside vegetation is visible on aerial photographs and has been confirmed by field observations. An example of typical roadside vegetation is shown in Photograph 7.1

- by panels installed as part of the approved project

- any views from these roads are usually from moving vehicles with the occupants facing forward, limiting the viewing angle. For this reason, the only potential impact of the modification is to slightly increase the duration and/or proximity of some views from some locations.

Viewpoint R5 is located adjacent to Birriwa Bus Route South and is indicative of potential views from this part of the road. It has been assessed as having a very low visual impact with nil to very limited views of the modification.

Photograph 7.1 Roadside vegetation at the intersection of Birriwa Bus Routes North and South

7.3 Summary of viewpoint analysis

The visual impact of the modification for all assessed viewpoints is rated as very low as summarised in Table 7.1.

Key findings of the assessment are:

- the highest anticipated visual impact rating for any private or public receivers is very low

- the modification infrastructure will be difficult to see from any public viewpoints other than locations on Birriwa Bus Route South within the modification area.

7.3.1 Comparison of modification and approved project viewpoints assessment

All viewpoints for the approved project were assessed as having a low or very low visual impact (EMM 2022, version 6 issued 2024 and EMM 2024).

For all viewpoints assessed in this LVIA, where an increase in any physical parameter of a view (angle of view, proximity or duration) increases due to the proposed modification, the increase is minor and any potential increase in visual impact is negligible. For this reason, the modification is not predicted to increase the visual impact rating for the approved project for any private receiver, as demonstrated by this report.

Note: the photograph for R5 was taken from a different location and facing a different direction to the photograph used in the approved project LVIA to capture the modification.

Table 7.1 Summary of assessed viewpoints

Location	Viewpoint type(s)	Distance to modification area (m)	VP sensitivity	Scenic quality	Visual sensitivity	Occupied cells – modification only	Magnitude rating – modification only	Visual impact rating – modification only	Occupied cells – approved project and modification	Magnitude rating– approved project and modification	Visual impact rating– approved project and modification
R3	Private	710	Low	Low	Low	3	Very low	Very low	8	Low	Low
R5	Private	740	Low	Low	Low	<1	Very low	Very low	<1	Very low	Very low
R12	Private	1,240	Low	Low	Low	7	Very low	Very low	16	Moderate	Low
R31	Private	1,600	Low	Low	Low	<1	Very low	Very low	<1	Very low	Very low
PVP-01	Public	1,600	Low	Low	Low	NA	Very low	Very low	NA	Low	Very low
PVP-02	Public	1,500	Low	Low	Low	NA	Very low	Very low	NA	Low	Very low
PVP-03	Public	Adjacent. (2,100 to BESS option B	Low	Low	Low	NA	Very low	Very low	NA	Very low	Very low
PVP-04	Public	1,700 (3,700 to BESS option B)	Low	Low	Low	NA	Very low	Very low	NA	Very low	Very low

8 Glint and glare analysis

8.1 Reflectivity and glare

Glint and glare are potential impacts of sunlight reflecting off the proposed solar project elements. When sunlight is reflected off a smooth, reflective surface, it can result in glint or glare. Glint refers to short, momentary periods of intense levels of exposure to reflection. Glare refers to sustained or continuous periods of exposure to excessive brightness, but at a reduced level of intensity. Glint is a quick reflection or flash of light, while glare is experience for a longer period of time. Both of these can be annoying and dangerous in certain situations by causing momentary blindness.

Reflection in the form of glint and glare will only be possible when direct sunlight occurs. Therefore, in those instances where glint and glare from the project elements may occur, people will also likely experience direct sunlight, which will be a significantly brighter and more intense source of light than reflections. Nonetheless, glint and glare may result from the project and may have an impact on receptors (dwellings within proximity of the development, motorists travelling along the local road network and pilots landing at or taking off from nearby runways).

8.1.1 Reflectivity

Generally, the light reflected is diminished by first hitting the substrate that reflected it. Since solar cells are designed to absorb light energy to create electrical currents, they will only reflect a portion of the sunlight that falls on them.

Typically, solar panels are constructed from a treated glass that is designed to minimise reflection and maximise the amount of light transmitted through the glass to the receptor. Typical treated glass that is used for solar cells reflects about 4% of the light that hits the cell. This is equivalent to a water body (pond or lake), which is considered to be a fairly low amount of reflection.

8.1.2 Angle of reflection

The angle of reflection of light off a reflective surface is directly related to the angle of incidence of the light from the source. In the case of a PV array, the sunlight will reflect off the panel at the same angle as it arrives from the sun. If the panel is stationary, the sun's angle relative to the solar panel will vary by time of day and therefore reflect toward the west in the morning and eastward in the evening.

The solar arrays proposed for this solar project will track the sun's movement across the sky to maximise exposure to the sun. Solar arrays can also use backtracking to minimise shading of one panel by another when the sun is low in the morning and afternoon. This may increase glare from the solar array at these times. This analysis assumes backtracking will not be used in this installation. The seasonal change of the sun's movements will vary the refection angles as well. As the sun move southward in the summer months, the reflection will move northward, and vice versa in the winter months (when the sun is north of the equator). This movement changes the reflection angle in a north-south direction.

8.2 Analysis

Knowing the characteristics of reflected light helps us determine where glare is likely to be an issue. In the case of the project, trackers will be used to maximise the sunlight absorbed by the cells. The trackers are designed to keep the panel perpendicular to the sun. We can therefore assume that the sunlight reflected will reflect perpendicular to the cell and directly back toward the sun for most of the daylight hours. For this analysis it assumed backtracking will not be used. The glare analysis below has been performed to identify the location that might experience glint or glare.

The Solar Guideline requires assessment of glint and glare impacts on the following receivers:

- residential receivers – up to 3 km from the source
- roads and rail lines – up to 1 km from the source
- aviation receivers – up to5 km from the source.

8.2.1 ForgeSolar glare analysis

A glare analysis was performed using specialised software (ForgeSolar). The calculations were based on the solar array properties outlined in Annexure C. Further parameters include:

- PV cells extend to 4.5 m above ground level with solar glass that has an anti-reflection surface treatment
- single axis tracking rotation aligned on a north-south axis, with a range of +/- 60^0 from vertical
- panels will not use backtracking.

The software calculates the minutes of potential glare predicted at each location every day through the course of a year. The results indicate the number of minutes predicted at each location along with the type of glare expected. The classifications of glare from the software are:

- Green glare – glare is present with only a low potential for temporary after-image or flash blindness
- Yellow glare – glare has a moderate potential for temporary after-image or flash blindness
- Red glare – glare with high potential for permanent eye damage.

The glare analysis produced by the software does not account for physical obstructions between the solar arrays and the residences and motorists. This includes the presence of buildings, trees and other structures. It also assumes the weather is sunny each day for the duration of daylight hours. Therefore, a worst-case scenario is calculated.

Glare impacts were assessed from surrounding residences within 3 km of the modification boundary, and from roads within 1 km of the modification boundary. This included 10 non-associated residences and a section of the Birriwa Bus Route South as shown in the report included in Annexure C.

There are no rail lines and no airfields within the distances from the modification area that require assessment under for glint and glare impacts under the Solar Guideline.

8.2.2 Results

Table 8.1 summarises the findings of the glare assessment. Refer to Annexure C for the full ForgeSolar glare analysis results.

Table 8.1 Glare analysis results

Receiver group	Impact	Glare impact rating
Residential	No glare predicted.	Low glare impact – no mitigation required
Road and rail	No glare predicted.	Low glare impact – no mitigation required
Aviation	No glare predicted.	Low glare impact – no mitigation required

Based on the glare analysis, the modification will not produce glare at any of the assessed receptors. No locations, residences or flight paths will have potential glare impacts.

8.2.3 Glint and glare conclusion

The modification solar panels will not use backtracking. Glare impacts will be avoided for all receivers if no backtracking is used.

9 Nighttime visual impacts

9.1 Existing nighttime visual environment

The main sources of night-time lighting are residential dwellings, especially those clustered in the village of Birriwa. Other farmhouse dwellings are located sporadically across the landscape and tend to be located individually, minimising the amount of light spilling into the sky.

Other sources include headlights from vehicles along the Castlereagh Highway and the Golden Highway and trains along the railway. The headlights tend to be focused light, illuminating the area in front of the vehicles.

9.2 Overview of potential impacts from night lighting

New light sources related to the project have the potential to extend visual impacts into the night. There are a number of existing light sources surrounding the project site that need to be considered in any light assessment. The existing light sources are associated with rural residences and motor vehicles travelling along the local roads.

Visual impacts from night lighting would likely be experienced by people who are outside in the landscape. The impact of night lighting is unlikely to be experienced from inside dwellings since internal lights reflect off windows and limit views of the exterior at night. The highest impact is expected to be on people who enjoy the outdoors at night, specifically night-sky enthusiasts, photographers and star gazers.

Potential sources of light sources include:

- lighting for safety and security on project infrastructure
- lighting for safety and security on ancillary structures.

9.3 Lighting during construction

During the construction period, construction activity is expected to be limited to normal construction hours. There is therefore no lighting anticipated for construction. During the construction period (approximately 28 months) there may be some night lighting used for security at the laydown and construction yards. This lighting is expected to be confined to a small area and because of the undulating topography and existing vegetation, impacts from construction lighting are expected to be negligible.

9.4 Project infrastructure lighting

The modification infrastructure that may need lighting at night includes the switchyard area and BESS location.

The modification infrastructure has been sited to minimise visibility from existing residences, public viewpoints. It is unlikely that the proposed lighting will create a noticeable impact on the existing nighttime lighting.

9.4.1 Ancillary lighting

In addition to project infrastructure, night lighting may be required on ancillary buildings, compounds, and roadways. These include permanent operations and maintenance (O&M) buildings, temporary construction compounds and permanent compounds.

At this stage of the project, the location and type of lighting required on these ancillary elements is yet to be confirmed. It is assumed that low-level lighting for security, maintenance, and emergency purposes.

9.4.2 Siding Spring Observatory Dark Sky Region

The Siding Spring Observatory (SSO) located in Coonabarabran NSW, is Australia's most important visible-light observatory. The night sky surrounding the observatory is protected from light pollution in the night sky by legislation. The *Dark Sky Planning Guideline* (2023) was developed by the then Department of Planning and Environment (DPE) to provide design guidelines that maintain the dark sky, and to improve lighting practices. The guidelines are directed at projects within the Siding Spring Observatory Dark Sky Region, which covers a radius of 200 km from the observatory.

The project is within the Dark Sky Region and should apply the design principles that are outlined in the *Dark Sky Planning Guideline* (2023). These principles do provide relevant guidance that can be applied to the lighting design.

It is also noted that during the exhibition and engagement process for the original development application for the project, the SSO did not raise concerns relating to the project.

9.4.3 Lighting design principles

Minimising light pollution of the night sky needs to be included in the design phases of the project.

Siting project elements can play a large role in reducing the visibility of any required lighting. Good use of the landscape to reduce lighting impacts include:

- use of landform to shield the project from view
- use of landscape elements (trees, mounding, walls) to shield effects of lighting from view.

Good lighting design can also minimise, and in some cases eliminate light pollution of the night sky. Design standards like AS 4282 *Control of obtrusive effects of outdoor lighting*, *National Light Pollution Guidelines for Wildlife* (2020), and the *Dark Sky Planning Guideline* (2023) should be applied during the design of project elements. Design guidelines adapted from these guidelines include:

- eliminating upward spill light
- directing light downwards, not upwards
- use of shielded fittings
- avoiding over lighting
- switching lights off when not required
- use of energy efficient bulbs
- use of asymmetric beams, where floodlights are used
- ensuring lights are not directed towards reflective surfaces
- use of warm white colours.

10 Mitigation measures

Performance objectives are provided in the Solar Guideline to indicate the level of action needed to avoid or mitigate the visual impacts identified in this LVIA. Additional; mitigation is not required for the proposed modification because no viewpoints have been assessed as potentially experiencing a visual impact higher than low.

Although additional mitigation is not required for the modification, the following visual impact mitigation recommended for the approved project should be employed. This includes measures such as:

- use finishes and products that minimise or eliminate surface glare
- select finishes and colours that are appropriate to the location and context to blend the development into surroundings. The visual impact of the BESS and associated structures can be minimised by careful selection of materials and colours. Neutral colours that blend in with the surrounding landscape will be used where possible, such as khaki, green, beige, or similar
- existing vegetation should be retained where possible to maintain existing levels of screening
- follow lighting design principles outlined in Section 9.4.3.

11 Conclusion

This LVIA has assessed the potential visual impact of the infrastructure associated with the proposed modification.

The existing visual environment surrounding the modification is characterised by historic and ongoing rural land uses on a landscape with gently rolling topography. Within the landscape character assessment boundary, two LCZs were identified, being agricultural plains and forested ridges.

Visual impacts of the modification on each LCZ were assessed as low for the agricultural plains LCZ and low – moderate for the forested ridges LCZ.

Within the visual study area 17 private receivers and four public viewpoints were identified. Based on interpretation of viewshed mapping, four private receivers and four public viewpoints were identified as requiring further assessment.

Potential visual impacts have been assessed as very low for all viewpoints. Key findings of the assessment are:

- the modification infrastructure will be difficult to see from any public viewpoints other than nearby locations on Birriwa Bus Route South
- the highest anticipated visual impact rating for any private receivers is very low.

The glint and glare assessment identified no glare impacts from the modification if no backtracking is used.

The modification is within the Siding Springs Dark Sky Region and application of good lighting design principles is required. It is unlikely that the additional ancillary lighting associated with the modification will create a noticeable impact on the existing nighttime lighting.

Because visual impacts have been rated as very low, no additional mitigation measures are required for the modification.

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Annexure A

LVIA assessment methodology

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A.1 Preliminary assessment

i Define visual study area and assessment boundaries

The studies for visual catchment area establish the area in which the project may be visible, who will see the project infrastructure, and the nature of the views at those points. A ZVI was developed to help determine the extent of visibility, and the locations that may be impacted. It was used as a guide for fieldwork, viewpoint selection and early detection of potential visual impacts.

ii Viewshed mapping

Viewshed mapping is used to supplement the preliminary assessment and to guide the selection of viewpoints for further assessment. It illustrates the area in the surrounding landscape from which the Project may be visible. It also indicates areas that have intervening hills or other landforms that block views.

This study uses a Zone of Visual Influence (ZVI) to map the viewshed (refer to Figure 5.1). It is generated using geographic information system (GIS) and is used to simulate the Project's visibility from the surrounding landscape. The ZVI has been restricted to a 4 km distance from the Project as this is the distance specified in the Technical Supplement.

The ZVI is used to select viewpoints by indicating areas that are predicted to have views into the project. Conversely, it indicates areas that are not predicted to have any views of the Project. With this knowledge, viewpoints can be selected from areas where the Project is visible.

It is important to note that the Technical Supplement requires that vegetation (trees) and built structures not be included in the mapping. The resulting maps can therefore only show where landforms obstruct views. This can be important for viewpoints that are located behind vegetation or buildings and have no views of the proposed development yet are assessed as having a potential impact in this LVIA.

iii Viewpoint selection

Viewpoints provide a representation of the likely changes a project will have on the landscape from a specific location. The effect a project has on the landscape can be illustrated photographically and evaluated consistently across the project..

a Viewpoint refinement

The refinement process eliminates viewpoints that have obstructed views of the project area. It also identifies viewpoints that can be grouped together and represented by a single, 'representative' viewpoint.

The viewpoints presented as part of this assessment are considered representative of potential visual impacts from a number of the locations identified as areas of concern by the local community and include local roads and private viewpoints from residential properties.

b Viewpoint classification

Viewpoints from residences undergo a classification process that determines the importance assigned to the view. Classification identifies whether a view is a primary view or a secondary view, with primary views considered more important than secondary views. Table A.1 identifies the classification.

Table A.1 Viewpoint classification

Primary viewpoint	Secondary viewpoint
Principal/frequented living spaces (living room, kitchen and dining area).	Less frequented living and service areas (bedrooms, laundries, bathrooms, garages and studies).
Front and rear views from a dwelling (porch, balcony, veranda, deck or patio).	Side views from a dwelling.

A.2 Landscape character assessment

This stage analyses and assesses the existing landscape character to measure the impacts the Project may have on the landscape. It involves recording and analysing the existing landscape features, characteristics, the way in which the landscape is experienced, and the value or importance placed on the landscape and visual resource of the site.

The landscape character is determined by the number, size, type and contrast of elements present. Typically, the key elements are topography, vegetation, water features and built elements. Other factors that are important are the consistency of these elements and whether they have developed progressively over time and become well integrated into a harmonious landscape. In addition, consideration must be given to the prevalence of change, including whether the landscape is experiencing large-scale development (such as residential growth on the urban fringe).

The impact of a project on the landscape character is based on the combination of the sensitivity of the existing landscape and the magnitude of the proposal on the landscape. According to the *Guideline for landscape character and visual impact assessment* (2020), sensitivity refers to the quality of an area, and how sensitive the existing character is to change. The context is a primary factor in the visual sensitivity of the view. Generally, sites within higher contrasting landscapes have greater ability to absorb change, whereas sites within a uniform or highly ordered landscape have higher sensitivity and less potential for absorption.

Magnitude refers to the physical scale of the Project in the landscape. This takes into account the size of the Project, distance from any viewing areas and the contrast it has to the surrounding landscape. Table A.2 has been developed to provide a rating for the impact of a project on landscape character.

Table A.2 Landscape character impact

Sensitivity of the landscape	Magnitude of change in the landscape		
	High	Moderate	Low
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

A.3 Visual impact assessment

A.3.1 Visual magnitude assessment

The visual magnitude is a measure of the apparent size of a project when viewed in the landscape. The larger a project appears to the viewer, the greater its visual impact will be. This assumes that a project covering 10% of the view will have more visual impact than a project occupying only 4% of the view.

To measure the visual magnitude of a project, the Solar Guideline requires that photographic evidence be used. The method of determining the magnitude is outlined below:

- Capture a panoramic photograph that covers 180 degrees of horizontal view.
- Create a photomontage by overlaying a 3D model of the project on to the panorama photograph.
- Overlay the Visual Magnitude Grid Tool on the photomontage.
- Identify and count the number of grid cells that the Project occupies.
- Determine the magnitude rating based on the number of cells occupied by the Project using the thresholds shown in Table A.3.

The magnitude rating is combined with the visual sensitivity rating (described below) to determine the visual impact rating (refer to Table A.7).

Table A.3 Visual magnitude thresholds

Number of occupied cells	Visual magnitude rating
1 to 7	Very low
8 to 14	Low
15 to 25	Moderate
26 to 36	High
>37	Very high

A.3.2 Visual sensitivity assessment

Visual sensitivity is a measure of the quality of the existing view and how sensitive the view is to change. The Solar Guideline uses two ratings to determine visual sensitivity:

- Viewpoint sensitivity – measures the relative importance of the viewpoint and the value that the community or visitors may place on the landscape being viewed. This measure applies to private viewpoints (dwellings) and public viewpoints (public use areas, roads).
- Scenic quality – the relative scenic, cultural or aesthetic value of the landscape. This is based on the presence or absence of key landscape features that the community values.

i Viewpoint sensitivity

Viewer sensitivity relates to the location of the viewer and the relative importance placed on the landscape viewed from that viewpoint by the community or visitors. These viewpoints include public use areas, public travel ways, and private homes.

Visual sensitivity has been assessed based on the viewer sensitivity level classification given in the Solar Guideline, presented in Table A.4.

Table A.4 Viewer sensitivity level classification

Sensitivity rating	Residential	Transport / infrastructure	Social / cultural
High viewpoint sensitivity	Dwellings in residential areas and rural villages (land zoned R1, R2, R3, R4, R5 and RU5). Historic rural homesteads/residences on the State or local Government Heritage List.	N/A	N/A
Moderate viewpoint sensitivity	Primary view from dwellings in rural areas (zoned RU1, RU2, RU3, RU4 and RU6), large lot residential areas (zoned R5) and in environmental or conservation areas (zoned C2, C3 and C4).	N/A	Tourist and visitor accommodation and places of worship (such as bed and breakfasts, motels, hotels). Tourist uses in tourist areas (zoned SP3). Publicly accessible green and open spaces including picnic areas, parks, public recreation areas. Town centres and central business districts.
Low viewpoint sensitivity	Secondary view from dwellings in rural areas (zoned RU1, RU2, RU3, RU4 and RU6), large lot residential areas (zoned R5) and in environmental or conservation areas (zoned C2, C3 and C4).	Tourist roads and scenic drives. Walking tracks and navigable waterways.	Cemeteries, memorial parks.
Very low viewpoint sensitivity	No place of residence present.	Local sealed and unsealed roads. Passenger rail lines with daily daylight services. State highways, freeways and classified main roads. Walking tracks and navigable waterways.	Private recreation areas and sporting fields (defined as land zoned RE2).

Source: Table 5 from Technical Supplement (DPE 2022).

ii Scenic quality

Scenic quality refers to the relative scenic or aesthetic value placed on the landscape by the community. This is based on the presence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality. The scenic quality classifications used in this assessment are identified in Table A.5.

Table A.5 Scenic quality classification

Scenic quality	Landforms	Vegetation	Waterbodies	Social / cultural	Human presence
High	Isolated peaks, steep rocky ridges, cones or escarpments with distinctive form and/or colour contrast that become focal points. Larger areas of distinctive rock outcrops or boulders. Well defined, steep sided valley gorges.	Strongly defined patterns with combinations of eucalypt forest, naturally appearing openings, streamside vegetation and/or scattered exotics. Distinctive stands of vegetation that may create unusual forms, colours or textures in comparison to surrounding vegetation.	Visually prominent lakes, reservoirs, rivers, streams, and swamps. Presence of harbour, inlet, bay or open ocean.	Culturally important sites, world heritage areas, national parks/reserves, Commonwealth and state heritage sites	Natural/undisturbed landscape Minimal evidence of human presence and production.
Moderate	Steep, hilly and undulating ranges that are not visually dominant. Broad shallow valleys. Moderately deep gorges or moderately steep valley walls. Minor rock outcrops.	Predominantly open forest or woodland combined with some natural openings in patterns that offer some visual relief. Vegetative stands that exhibit a range of size, form, colour, texture and spacing, including human influenced vegetation such as vineyards and orchards.	Intermittent streams, lakes, rivers, swamps, and reservoirs.	Local heritage sites Distinguishable entry ways to a regional city identified in the Transport and Infrastructure SEPP.	Dispersed yet evident presence of human settlement such as villages, small towns, isolated pockets of production and industry, lower scale and trafficked transport infrastructure.
Low	Large expanses of flat or gently undulating terrain. Indistinct, dissected, or unbroken landforms that provide little illusion of spatial definition or landmarks.	Extensively cleared and cropped areas with very limited variation in colour and texture. Pastoral areas, human created paddocks, pastures or grasslands and associated buildings typical of grazing lands.	Natural waterbody absent. Farm dams, irrigation canals or stormwater infrastructure.	Places of worship, cemeteries/memorial parks, private open spaces.	Dominating presence of infrastructure, human settlements, highly modified landscapes and higher density populations such as regional cities, industrial areas, agricultural transport or electricity infrastructure.

Source: Table 6 from Technical Supplement (DPE 2022).

The two visual sensitivity ratings above are combined to form the visual sensitivity rating using the matrix presented in Table A.6. This combined rating is the visual sensitivity rating.

Table A.6 Visual sensitivity rating

Viewpoint sensitivity	Scenic quality			
	High	Moderate	Low	Very low
Very high	High	High	Moderate	Moderate
High	High	Moderate	Moderate	Low
Moderate	Moderate	Moderate	Low	Low
Low	Moderate	Low	Low	Very low
Very low	Low	Low	Very low	Very low

A.3.3 Visual impact assessment

The amount of visual impact is a function of the magnitude of that change when considered against the sensitivity of the view. Table A.7 provides a matrix that combines the visual sensitivity rating with the magnitude rating to determine the visual impact rating. This rating is applied to each viewpoint to measure the visual impacts of a development from specific locations.

Table A.7 Visual impact rating

Magnitude of change	Visual sensitivity			
	High	Moderate	Low	Very low
Very high	High	High	Moderate	Moderate
High	High	Moderate	Moderate	Low
Moderate	Moderate	Moderate	Low	Low
Low	Moderate	Low	Low	Very low
Very low	Low	Low	Very low	Very low

A.4 Performance objectives and mitigation

Performance objectives are provided in the Solar Guideline to indicate the level of action needed to avoid or mitigate the visual impacts identified in this LVIA. This stage is not required for this LVIA because no viewpoints have been assessed as potentially receiving a visual impact higher than low.

Annexure B

Viewpoint assessments

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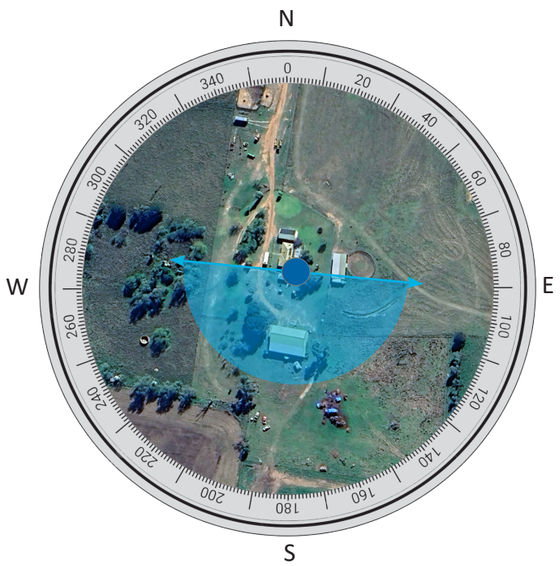
Viewpoint R3 - 831 Birriwa Bus Route North, Birriwa

Panoramic view of existing site

Panoramic photomontage with approved project and modification

Angle (degrees) of horizontal view



Coordinates (Long, Lat)	149.510050, -32.114311
Distance to modification area	710m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	3 (very low)
Magnitude rating	Very low
Visual impact rating	Very low

Visual sensitivity discussion

Installation of solar panels in the modification area will not reduce the distance from this viewpoint to the nearest solar panel because parts of the approved project are significantly closer to the residence than the modification area.

Where the modification area is visible to the left of the shed, installation of panels in the modification area will likely lead to a slight increase in visual impact due to increased number of panels being visible and their slightly closer distance. There will also be a slight increase in the horizontal angle occupied by solar panels.

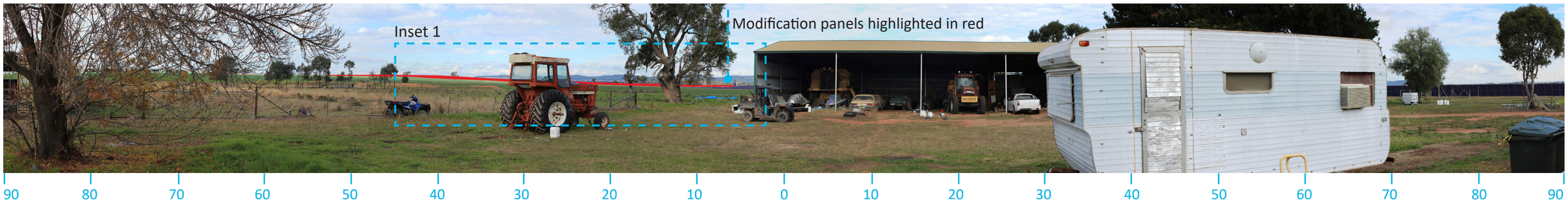
On the following page a photomontage with a magnitude grid overlayed shows that a total of three cells are occupied by the modification, resulting in a very low magnitude rating.

The final photomontage for this viewpoint has the magnitude grid applied to the approved project and to the modification with eight cells occupied, resulting in a low magnitude rating.

Viewpoint R3 - 831 Birriwa Bus Route North, Birriwa

Panoramic photomontage with visual impact magnitude grid applied to the modification components

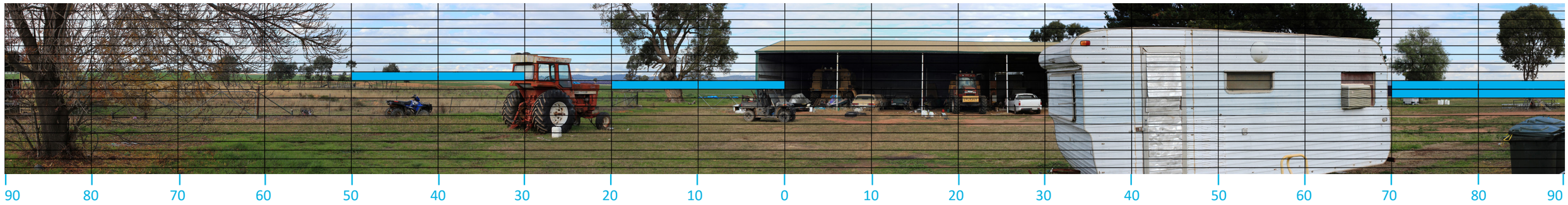
Panoramic photomontage of the approved project and modification, with modification solar panels highlighted



Inset 1 - 50mm detail showing solar panels that are part of the approved project and the modification

Viewpoint R3 - 831 Birriwa Bus Route North, Birriwa

Panoramic photomontage with visual impact magnitude grid applied to the approved project and to the modification



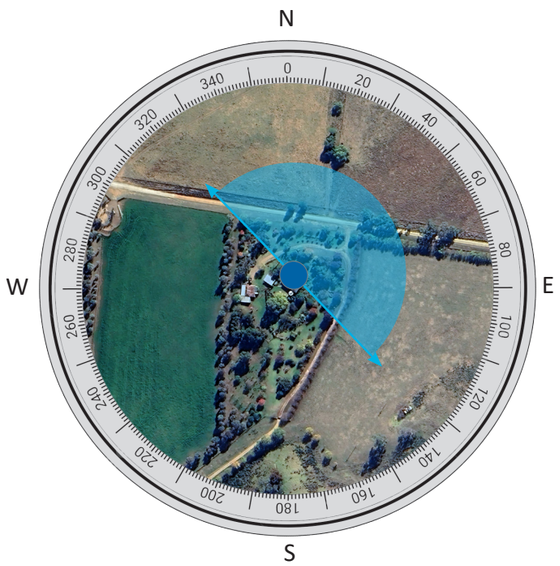
Coordinates (Long, Lat)	149.510050, -32.114311
Distance to modification area	710m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	8 (low)
Magnitude rating	Low
Visual impact rating	Low

Viewpoint R5 - Birriwa Bus Route South, Birriwa

Panoramic view of existing site

Panoramic photomontage of proposed development

Angle (degrees) of horizontal view



Coordinates (Long, Lat)	149.518055, -32.136110
Distance to modification area	740m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	0 (very low)
Magnitude rating	Very low
Visual impact rating	Very low

Visual sensitivity discussion

Depending on the final solar panel layout, it is likely that panels that are part of the approved project will be installed between this viewpoint and the modification area.

From this location, it is expected that no part of the modification infrastructure will be visible due to the site topography. This is expected to be the case for most locations near or inside the house, however it is possible that glimpses of modification infrastructure (including solar panels and the BESS) may be obtained from some points near the house. If this does occur, it is likely that panels that are part of the approved project will block views to the more distant modification infrastructure, further reducing any possible visual impact from the modification.

Because no view is anticipated, the visual impact is rated as very low.

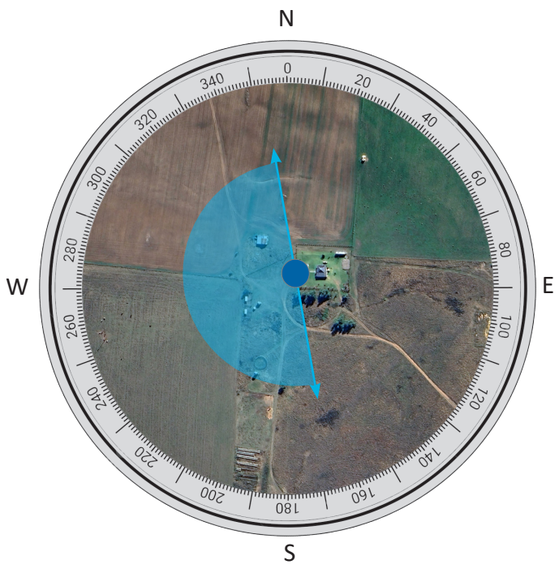
The viewpoint sensitivity rating used reflects this viewpoints residential character in a rural land zone.

Viewpoint R12 - “Eden” 678 Birriwa Bus Route North

Panoramic view of existing site

Panoramic photomontage with approved project and modification

Angle (degrees) of horizontal view



Coordinates (Long, Lat)	149.549790, -32.123535
Distance to modification area	1,240 m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	7 (very low)
Magnitude rating	Very low
Visual impact rating	Very low

Visual sensitivity discussion

Installation of the solar panels and BESS that are part of the modification will increase the horizontal angle occupied by the project from this location. This will likely lead to an increase in visibility of the project from this location.

The extent of solar panels and BESS containers shown in the photomontages shows a worst-case scenario using maximum available land within the modification area. The final extent of the modification will be less than that shown.

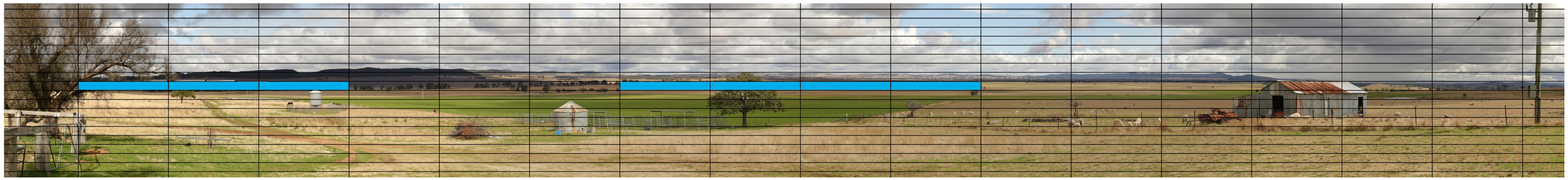
Additional traffic on Birriwa Bus Route South as a result of the modification may be visible from this location. Any visual impact from this additional traffic is anticipated to be minor.

On the following page a photomontage with a magnitude grid overlayed shows that a total of seven cells are occupied by the modification, resulting in a very low magnitude rating.

The final photomontage for this viewpoint has the magnitude grid applied to the approved project and to the modification with 16 cells occupied, resulting in a moderate magnitude rating.

Viewpoint R12 - “Eden” 678 Birriwa Bus Route North

Panoramic photomontage with visual impact magnitude grid applied to the modification components

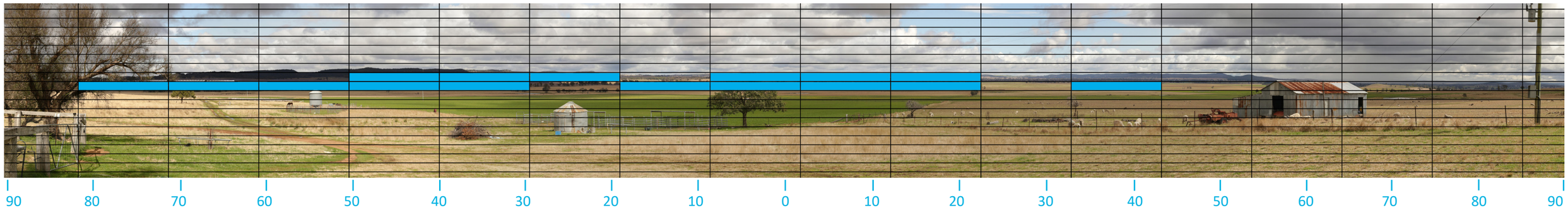


Panoramic photomontage of the approved project and modification, with modification solar panels highlighted

Inset 1 - 50mm detail showing BESS infrastructure and solar panels that are part of the approved project

Viewpoint R12 - “Eden” 678 Birriwa Bus Route North

Panoramic photomontage with visual impact magnitude grid applied to the approved project and to the modification



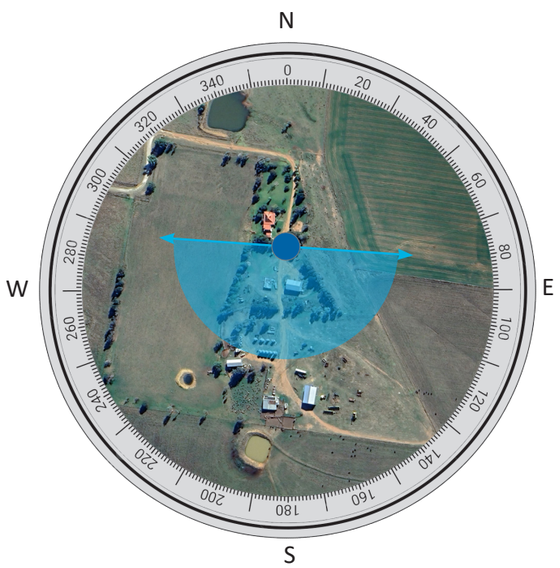
Coordinates (Long, Lat)	149.549790, -32.123535
Distance to modification area	1,240 m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	16 (moderate)
Magnitude rating	Moderate
Visual impact rating	Low

Viewpoint R31 - 678 Birriwa Bus Rte North, Birriwa

Panoramic view of existing site

Panoramic photomontage with approved project and modification

Angle (degrees) of horizontal view



Coordinates (Long, Lat)	149.541272, -32.108810
Distance to modification area	1,600 m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	0 (very low)
Magnitude rating	Very low
Visual impact rating	Very low

Visual sensitivity discussion

In comparison to the approved project, installation of solar panels in the modification area will reduce the distance from this viewpoint to the nearest solar panel from approximately 2,400 m to 1,600 m. However this reduced distance occurs over only a small horizontal angle where views of the modification area are largely obscured by existing vegetation.

On the following page a photomontage with a magnitude grid overlayed shows that no cells are occupied by the modification, resulting in a very low magnitude rating.

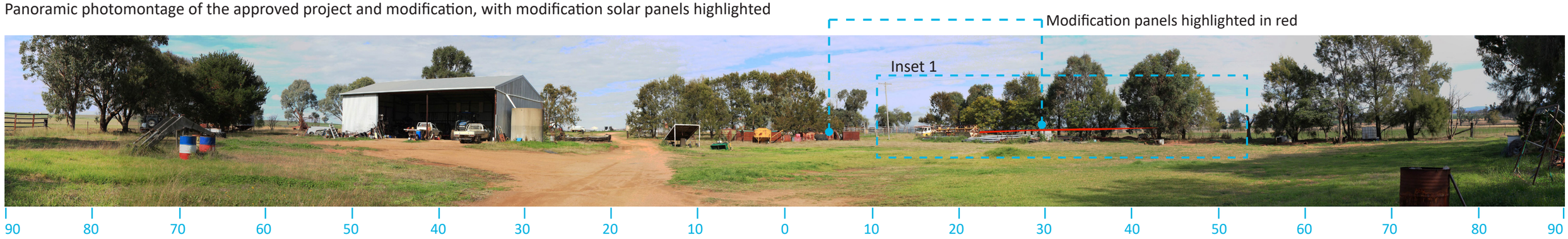
The final photomontage for this viewpoint has the magnitude grid applied to the approved project and to the modification with no cells occupied, resulting in a very low magnitude rating.

Viewpoint R31 - 678 Birriwa Bus Rte North, Birriwa

Panoramic photomontage with visual impact magnitude grid applied to the modification components

Note: no cells are more than 25% occupied by modification infrastructure.

Panoramic photomontage of the approved project and modification, with modification solar panels highlighted



Inset 1 - 50mm detail showing solar panels that are part of the approved project and the modification

Viewpoint R31 - 678 Birriwa Bus Rte North, Birriwa

Panoramic photomontage with visual impact magnitude grid applied to the approved project and to the modification

Note: no cells are more than 25% occupied by approved project or modification infrastructure.

Coordinates (Long, Lat)	149.541272, -32.108810
Distance to modification area	1,600 m
Viewpoint type	Residential dwelling
Viewpoint sensitivity	Low
Scenic quality	Low
Visual sensitivity	Low
Occupied Cells	0 (very low)
Magnitude rating	Very low
Visual impact rating	Very low

Annexure C

Glint and glare report

EMM
creating opportunities

FORGESOLAR GLARE ANALYSIS

Project: **Birriwa Mod 1**
Mod 1 panels only, excluding approved project

Site configuration: **Mod 1 - no backtracking**

Created 11 Apr, 2025
Updated 11 Apr, 2025
Time-step 1 minute
Timezone offset UTC10
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 5 MW to 10 MW
Site ID 146608.24724

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 3	SA tracking	SA tracking	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

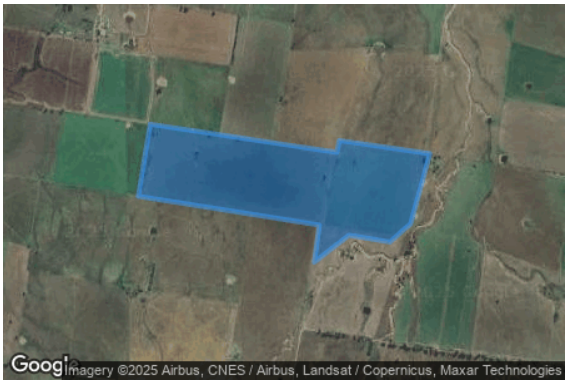
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	0	0.0	0	0.0

Component Data

PV Arrays

Name: PV array 1
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.119905	149.513226	423.44	2.50	425.94
2	-32.121541	149.526057	430.89	2.50	433.39
3	-32.120850	149.526229	431.09	2.50	433.59
4	-32.121614	149.532452	428.69	2.50	431.19
5	-32.125684	149.531121	431.94	2.50	434.44
6	-32.126738	149.529694	434.27	2.50	436.77
7	-32.126338	149.526894	434.89	2.50	437.39
8	-32.127901	149.524512	438.15	2.50	440.65
9	-32.125757	149.524856	435.17	2.50	437.67
10	-32.124085	149.512410	431.19	2.50	433.69

Name: PV array 2
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.129986	149.523907	441.02	2.50	443.52
2	-32.128205	149.527340	436.01	2.50	438.51
3	-32.128496	149.529572	434.89	2.50	437.39
4	-32.132094	149.528542	438.96	2.50	441.46
5	-32.131549	149.523692	441.68	2.50	444.18

Name: PV array 3
Axis tracking: Single-axis rotation
Backtracking: None
Tracking axis orientation: 0.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.122245	149.534808	428.83	2.50	431.33
2	-32.122426	149.536910	427.68	2.50	430.18
3	-32.132930	149.535237	440.48	2.50	442.98
4	-32.132385	149.530559	438.72	2.50	441.22
5	-32.127369	149.532275	432.75	2.50	435.25

Route Receptors

Name: Birriwa Bus Route South
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	-32.134785	149.510446	457.75	1.50	459.25
2	-32.136457	149.522806	448.45	1.50	449.95
3	-32.131805	149.523493	441.58	1.50	443.08
4	-32.135239	149.552160	450.16	1.50	451.66

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
OP 1	1	-32.136317	149.518047	459.70	1.50
OP 2	2	-32.123531	149.550134	463.44	1.50
OP 3	3	-32.131886	149.562639	446.78	1.50
OP 4	4	-32.113461	149.556243	435.94	1.50
OP 5	5	-32.101711	149.535967	421.15	1.50
OP 6	6	-32.108371	149.541122	424.44	1.50
OP 7	7	-32.114176	149.510024	417.25	1.00
OP 8	8	-32.095566	149.525541	415.77	1.50
OP 9	9	-32.101805	149.496675	414.65	1.50
OP 10	10	-32.102846	149.494669	416.16	1.50

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV array 1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV array 3	SA tracking	SA tracking	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0

PV: PV array 1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0

PV array 1 and Route: Birriwa Bus Route South

No glare found

PV array 1 and OP 1

No glare found

PV array 1 and OP 2

No glare found

PV array 1 and OP 3

No glare found

PV array 1 and OP 4

No glare found

PV array 1 and OP 5

No glare found

PV array 1 and OP 6

No glare found

PV array 1 and OP 7

No glare found

PV array 1 and OP 8

No glare found

PV array 1 and OP 9

No glare found

PV array 1 and OP 10

No glare found

PV: PV array 2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0

PV array 2 and Route: Birriwa Bus Route South

No glare found

PV array 2 and OP 1

No glare found

PV array 2 and OP 2

No glare found

PV array 2 and OP 3

No glare found

PV array 2 and OP 4

No glare found

PV array 2 and OP 5

No glare found

PV array 2 and OP 6

No glare found

PV array 2 and OP 7

No glare found

PV array 2 and OP 8

No glare found

PV array 2 and OP 9

No glare found

PV array 2 and OP 10

No glare found

PV: PV array 3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
Birriwa Bus Route South	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0

PV array 3 and Route: Birriwa Bus Route South

No glare found

PV array 3 and OP 1

No glare found

PV array 3 and OP 2

No glare found

PV array 3 and OP 3

No glare found

PV array 3 and OP 4

No glare found

PV array 3 and OP 5

No glare found

PV array 3 and OP 6

No glare found

PV array 3 and OP 7

No glare found

PV array 3 and OP 8

No glare found

PV array 3 and OP 9

No glare found

PV array 3 and OP 10

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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