Appendix G

Visual impact assessment

Orange Grove Sun Farm

Overland Sun Farming

Orange Grove Sun Farm

Visual impact assessment

Prepared for Orange Grove Sun Farm Pty Ltd | 11 May 2018

Orange Grove Sun Farm

Visual impact assessment

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Orange Grove Sun Farm

Final

Report J17210RP1 | Prepared for Orange Grove Sun Farm Pty Ltd | 11 May 2018

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Executive Summary

OVERLAND Sun Farming Pty Ltd (OVERLAND) on behalf of Orange Grove Sun Farm Pty Ltd (the proponent) proposes to develop the Orange Grove Sun Farm, a large-scale solar photovoltaic (PV) generation facility and associated building and electrical infrastructure including grid connection works in the Brigalow Belt South Bioregion of northern NSW (the project). The project is within the Gunnedah Shire local government area (LGA) and is approximately 12 km east of the township of Gunnedah.

A visual assessment was completed for the project to assess impacts from six representative viewpoints surrounding the development footprint. The viewpoints were selected to represent views close to private residential properties and road corridors (ie Orange Grove Road) nearest to the project's development footprint.

The assessment method adopted was based on methods outlined in the *Guidelines for Landscape and Visual Impact Assessment Third Edition* (2013) (the GLVIA) and the *Wind Energy: Visual Assessment Bulletin AB 01 For State significant wind energy development* (2016) (the VA Bulletin).

The project design, development footprint and placement of infrastructure have progressively evolved to minimise or avoid visual impacts. Nonetheless, the development of the project will result in some changes to the landscape. Visual impacts will commence during the construction stage and continue throughout the duration of the operation stage of the project.

The visual assessment determined that, of the viewpoints assessed, infrastructure may be visible to varying degrees from five viewpoints. Based on the presence of vegetation, combined with the relatively low height of the project's infrastructure, the impact assessment predicts:

- a negligible visual impact for Viewpoint 6;
- a slight/moderate visual impact for viewpoints 3, 4 and 5;
- a moderate visual impact for Viewpoint 2 (representative of views from R2); and
- a potentially significant impact for Viewpoint 1 (representative of views from R1) for the unmitigated scenario.

As a result of its close proximity to the western boundary of the development footprint, without the implementation of appropriate mitigation measures, R1 will be exposed to views of project infrastructure. Although a significant level of vegetation was observed along the eastern boundary of this property, this vegetation is unlikely to provide a sufficient level of mitigation to reduce the visual impacts experienced from this viewpoint during the operation of the project. The proponent will provide landscape screening to mitigate the visual impacts from R1.

As illustrated in Photograph 5.5, the relatively low height of the project infrastructure and distance to the development footprint will limit the scale of change and degree of contrast for any views from R2, which is approximately 760 m north-east of the northern portion of development footprint. The proponent will provide landscape screening to further reduce the visibility of project infrastructure from R2.

The final location and extent of landscaping at R1 and R2 will be determined during detailed design and following subsequent discussions with the project landowners and the property owners of R1 and R2 as part of preparation of the EMP.

The construction of the project and the Gunnedah Solar Farm will expand the overall area within the Gunnedah Shire LGA that is occupied by solar infrastructure. Based on the relatively low height of the dominant project infrastructure, namely the PV solar panels, and separation distances between the development footprint for the project and the Gunnedah Solar Farm, it is anticipated that there is limited potential for significant combined views of the project and the Gunnedah Solar Farm.

This VIA concludes that the implementation of additional mitigation measures, namely landscaping at R1 and R2, will ensure that the project will not have any significant adverse visual impacts on the locality.

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1 Introduction

1.1 Overview

OVERLAND Sun Farming Pty Ltd (OVERLAND) on behalf of Orange Grove Sun Farm Pty Ltd (the proponent) proposes to develop the Orange Grove Sun Farm, a large-scale solar photovoltaic (PV) generation facility and associated building and electrical infrastructure including grid connection works near the township of Gunnedah, in the Brigalow Belt South Bioregion of northern NSW (Figure 1.1) (the project). The project is within the Gunnedah Shire local government area (LGA) and is approximately 12 km east of the township of Gunnedah.

The project is a State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). A development application (DA) for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning, or the Minister's delegate, is the consent authority.

An environmental impact statement (EIS) is a requirement of the approval process. This visual impact assessment (VIA) report forms part of the EIS. It documents the visual assessment methods and results and the initiatives built into the project design to avoid or minimise visual associated impacts.

1.2 Project description

The project includes the development, construction and operation of a solar PV electricity generation facility, which comprises the installation of PV solar panels, electrical cabling, electrical switch yard / substation, electrical connection to the TransGrid network and other associated infrastructure within the development footprint.

The project will connect to the TransGrid 132 kilovolt (kV) electricity distribution network that feeds TransGrid's Narrabri to Gunnedah and Gunnedah to Tamworth network system. The electricity generated from the project will be sold to one or more of a registered energy retailing organisation, large energy user (governmental or private) or to the National Electricity Market that is managed by the Australian Energy Market Operator.

As an indication of scale, based on current technologies, the estimated total installed capacity will be in the order of 110 MW, which would be generated by approximately 330,000 PV solar panels.

The project comprises the following key components:

- a network of PV solar panel arrays including supporting structures and tracker system;
- an internal network of electrical collection and distribution systems including electrical inverters;
- an internal network of communications and control cabling and systems;
- switchyard including electrical switching, control and monitoring equipment, electrical transformation system and operational control room;
- electrical connection and communications cabling from the on-site switchyard and transformation area to the TransGrid 132 kV electrical network;

- a management hub, including material storage areas, demountable offices, amenities and equipment sheds;
- provision of land area within the development footprint for possible future energy storage and network support devices; and
- fencing, access roads from adjacent public roadways, on-site parking and internal access roads.

The project may include the installation of battery and energy storage devices within a secure compound within the development footprint. The rated capacity of future battery and energy storage devices has not been determined at this stage of project development. The inclusion of such energy storage devices will be determined during the detailed design stage of the project, and will be dependent on network integration and commercial considerations at such time. A modification to the consent would be sought to permit installation of this infrastructure within the development footprint if required.

The development footprint and conceptual infrastructure layout has been refined on the basis of grid connection studies, environmental constraints identification, stakeholder engagement and design of project infrastructure with the objective of developing an efficient project that avoids or minimises environmental impacts. The development footprint and conceptual infrastructure layout are discussed in Chapter 4.

1.3 Assessment guidelines and requirements

This VIA has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

There are no Commonwealth, NSW or local government planning policies, guidelines or standards directly applicable to this assessment. The VIA was prepared with reference to the methods outlined in:

- *Guidelines for Landscape and Visual Impact Assessment Third Edition* (2013) (the GLVIA), prepared by the Landscape Institute and Institute of Environmental Management and Assessment; and
- *Wind Energy: Visual Assessment Bulletin AB 01 For State significant wind energy development* (2016a) prepared by the NSW Department of Planning and Environment (the VA Bulletin).

It is noted that the VA Bulletin specifically relates to assessment of visual impacts of wind farms in NSW; however, a number of the methods for describing visual sensitivity and landscape character are considered to be relevant to this assessment. In the absence of other directly applicable guidelines/standards, the relevant elements from the VA Bulletin have been adopted for this assessment.

The draft *Large-Scale Solar Energy Guideline for State Significant Development* (the draft guideline) was released by the NSW Government in 2017 and provides 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 SSD.

Visual impacts, namely the acceptability of 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 draft guideline and have been considered in detail within this VIA.

The draft guideline also recommends consideration of cumulative impacts from other developments (proposed, approved and operating), including potential visual impacts where multiple solar

developments may be constructed in close proximity to each other. Cumulative impacts of the project are discussed further in Section 5.6.

This VIA was prepared in accordance with the requirements of the NSW Department of Planning and Environment (DPE), which were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 20 December 2017. The SEARs identify matters that must be addressed in the EIS. A copy of the SEARs is attached to the EIS as Appendix A, while Table 1.1 lists the individual requirements relevant to this VIA and where they are addressed in this report.

Table 1.1 Relevant SEARs

Requirement	Section addressed
Visual – including:	
• An assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners.	Chapter 5

To inform preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs. Copies of the government agencies' advice to DPE were attached to the SEARs.

One agency, the NSW Roads and Maritime Services (RMS), raised a matter relevant to the visual assessment. The matter raised is listed in Table 1.2.

Table 1.2 RMS's comments: assessment recommendations

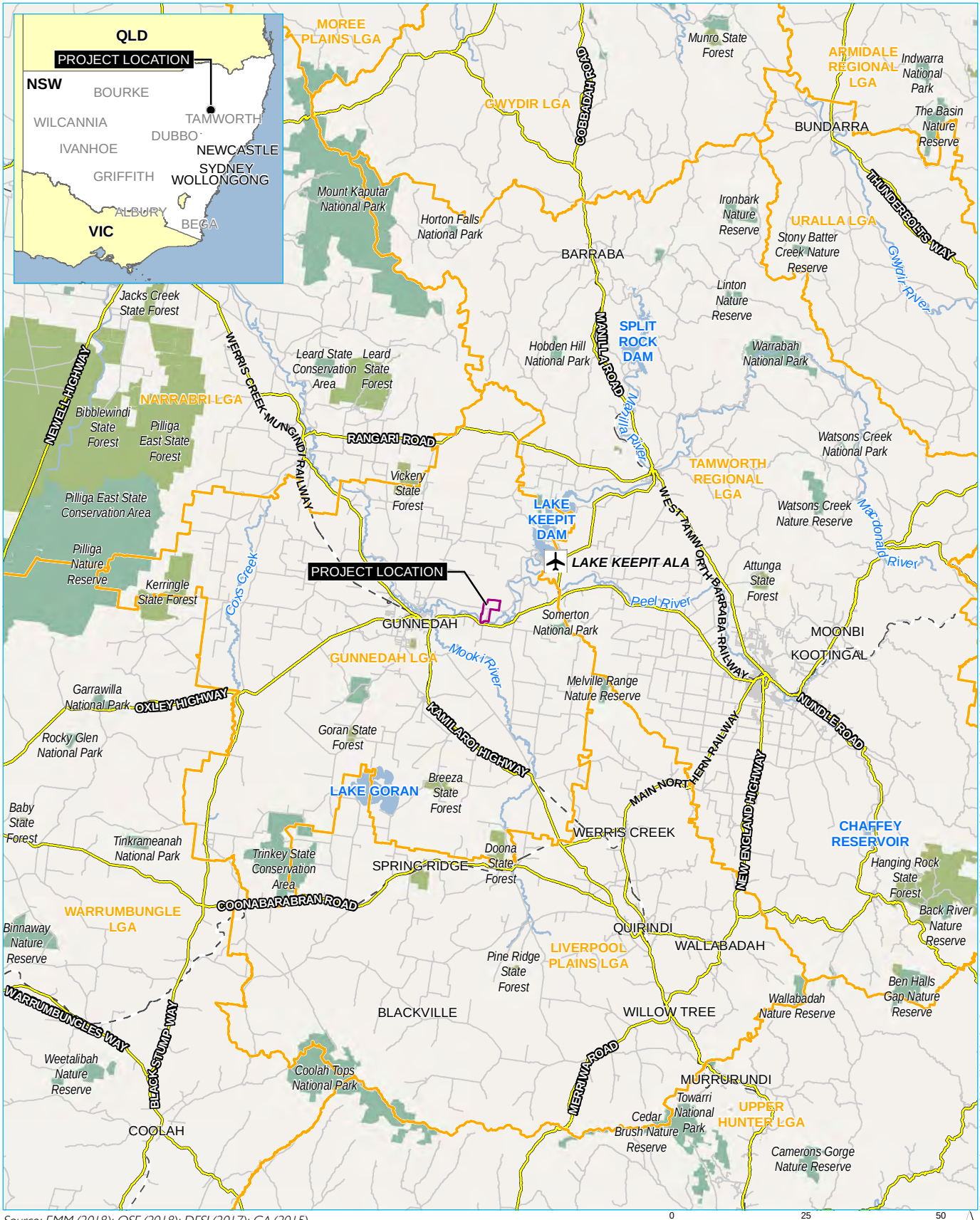
Requirement	Section addressed
Consideration of the impact of glare and/or reflectivity of infrastructure visible from public roads	Section 5.4

In addition, Gunnedah Shire Council (GSC) requested that the EIS address potential impacts of any solar glare from the project on inbound aircraft to the Gunnedah Airport. Potential reflectivity and glare impacts from the project are addressed in Section 5.4.

1.4 Structure of the report

This report is structured as follows:

- Chapter 2 describes the visual impact assessment methodology adopted in the preparation of this report;
- Chapter 3 describes the existing landscape within which the project will be sited;
- Chapter 4 describes the character of the visual components of the project and the staging of project development;
- Chapter 5 describes the impacts of the project from representative viewpoints in and around the site; and
- Chapter 6 provides conclusions.



Source: EMM (2018); OSF (2018); DFSI (2017); GA (2015)

0 25 50 km

GDA 1994 MGA Zone 56

N

KEY

- Orange Grove Sun Farm site boundary
- Local government area (LGA) boundary
- Rail line
- Main road
- Local road
- Major waterway
- Waterbody
- NPWS reserve
- State forest

Regional project location

Orange Grove Sun Farm
Visual impact assessment
Figure 1.1

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2 Assessment methodology

2.1 Overview

The assessment method used in this report is that outlined in the GLVIA and VA Bulletin, which involves information review, consultation, field observations and photography, computer-based data processing and analysis, and application of subjective professional judgement. The assessment involved seven key stages:

Stage 1: **View type and context** – the existing landscape baseline is described noting its character and complexity;

Stage 2: **Visibility baseline assessment** – the zone of visual influence of the project is established, where appropriate, through the use of computer generated zones of theoretical visibility, based on topographical data, or through fieldwork analysis. This establishes the locations where views of the project may be possible. Fieldwork is undertaken to establish the types and locations of receptors within this theoretical zone;

Stage 3: **Viewpoint selection** – representative public and private viewpoints of the site are selected and the project's level of exposure to them is determined;

Stage 4: **Magnitude of change** - the magnitude of visual change and the changes arising from the project are assessed and the need for project modifications or other mitigation measures evaluated;

Stage 5: **Visual sensitivity** – the capacity of the landscape to absorb change without a loss of quality (its visual sensitivity) is determined;

Stage 6: **Evaluation of significance** – the significance of change in the landscape is a function of the magnitude of change when considered against the view type/context and the sensitivity of a receptor; and

Stage 7: **Mitigation** – the modified and mitigated project (if applicable) is assessed, the final visual impacts are described and illustrated and their significance documented.

Details of each of the above stages are provided below.

2.2 Stages in the assessment methodology

2.2.1 Stage 1 – View type and context

This stage involves recording and analysis of existing landscape features, characteristics, the way in which the landscape is experienced, and the value or importance of the landscape and visual resource in the development footprint. 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 overtime 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 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.

Reference has been made to the landscape characters defined in the VA Bulletin and descriptions provided in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995). The GLVIA also sets out guidance in relation to landscape baseline at paragraph 5.3:

> Baseline studies for assessing landscape effects require a mix of desk study and field work to identify and record the character of the landscape and the elements, features and aesthetic and perceptual factors which contribute to it. They should also deal with the value attached to the landscape....The methods used should be appropriate to the context into which the development proposal will be introduced and in line with current guidance and terminology.

2.2.2 Stage 2 – Visibility baseline assessment

Baseline studies for visual effects establish the area in which the development may be visible, who will see the development, the viewpoints that will be affected and the nature of the views at those points. Viewshed analysis using GIS has been used to simulate visibility from viewpoints and the surrounding landscape.

2.2.3 Stage 3 – Viewpoint selection

Viewpoints are selected to provide a representative sample of the likely visual landscape changes on the different users of the areas surrounding the project and their visual exposure to various project elements. Viewpoints that are considered to have potential exposure to various project elements or areas available to public access, such as roads, and private viewpoints from residential properties surrounding the project, have been identified through GIS mapping, fieldwork and desktop analysis.

2.2.4 Stage 4 – Magnitude of change

The magnitude of change on the visual landscape is one factor in determining the significance of visual impacts of the project. In accordance with the GLVIA, this visual assessment considered the following criteria in determining the magnitude of change on a receptor:

- whether the impact is temporary or permanent – impacts that are for a limited duration are considered less significant than those that occur for an extended period or are permanent;
- scale of change – the loss or addition of features in the view and changes in the proportion of the view affected by the project;
- degree of contrast – level of integration of new features with existing or remaining landscape elements, having regard to form, scale, height, colour, and texture;
- distance of the viewer from the altered elements in the landscape – close proximity to an altered landscape will increase the significance for private residences. In the case of motorists, mid ground changes can be greater than foreground elements as they can result in longer viewing times. Glare and reflection has also been considered in regards to motorists;
- viewing direction – whether the change is to the primary view from the receptor;

- extent of view affected – impacts that are visible over a greater portion of a view are more significant than those where only a part of the view is impacted. Intervening topography and vegetation will also affect the magnitude of change; and

- length of viewing time – views from a residence are constant whereas some views from roadways as experienced by motorists may be brief dependent upon speed and viewing direction.

2.2.5 Stage 5 – Visual sensitivity

Visual sensitivity is a measure of the landscape's ability to absorb development without a significant change in the character. It is a function of the view type and context. In this assessment, the major factor influencing visual sensitivity is the level of contrast between the project related infrastructure and the rural landscape setting in which it will be set.

The physical characteristics of the landscape, including existing development features, are integral components in determining the visual sensitivity. For example, a low visual sensitivity would enable a modification or addition to be made to the landscape which would only cause minimal contrast and result in a high level of integration with the surrounding landscape. Similarly, a high visual sensitivity would mean the same modification or addition to the surrounding landscape would cause high contrast to the surrounding landscape.

Visual sensitivity has been assessed based on the viewer sensitivity level classification given in the VA Bulletin, presented in Table 2.1.

Table 2.1 Viewer sensitivity level classification

Sensitivity	Description
High	Residential areas and rural villages (defined as land zoned R1, R2, R3, R4, R5 and RU5 in the Standard Instrument Local Environmental Plan [LEP]).
	Recreation, cultural or scenic sites and viewpoints of National or State significance.
	Any buildings, historic rural homesteads/residences on the State or local Government Heritage List.
Moderate	Rural dwelling(s).
	Tourist and visitor accommodation (definition in Standard Instrument LEP).
	Recreation, cultural or scenic sites and viewpoints of regional significance.
Low	Interstate and state passenger rail lines with daily daylight services.
	State highways, freeways and classified main roads, classified tourist roads.
	Land management roads with occasional recreation traffic.
	Walking tracks of moderate local significance or infrequent recreation usage.
	Other low use and low concern viewpoints and travel routes.
	Navigable waterways.

The VA Bulletin establishes sensitive land use designations, including key National and State sensitive land use designations, along with potentially sensitive land use zones in the local environmental plans prepared under the EP&A Act. These National and State sensitive land use designations and land use zones are identified in Table 2.2.

Table 2.2 Sensitive land use designations

National and State sensitive land use designations	LEP zones as per the NSW Standard LEP	
World Heritage Areas	RU5 Village	RE2 Private Recreation
National Parks	R1 General Residential	E1 National Parks and Nature Reserves
National Reserve System reserves	R2 Low Density Residential	E2 Environmental Conservation
Coastal Zone (under the NSW *Coastal Protection Act 1979*)	R3 Medium Density Residential	E3 Environmental Management
Marine estate (under the NSW *Marine Estate Management Act 2014)*	R4 High Density Residential	E4 Environmental Living
Commonwealth Heritage List Sites	R5 Large Lot Residential	W1 Natural Waterways
State Heritage Register Sites	SP3 Tourist	W2 Recreational Waterways

Notes: Table 3 from VA Bulletin (DPE 2016a).

The site is not located within a sensitive land use designation or within a potentially sensitive land use zone. The nearest sensitive land use zone is approximately 1.6 km north-east of the northern portion of the development footprint and is zoned E3 Environmental Management under the Gunnedah Local Environmental Plan 2012 (Gunnedah LEP) (refer to Figure 3.2). In addition, the majority of the village of Carroll, approximately 3.4 km south-east of the site is zoned RU5 Village under the Gunnedah LEP (refer to Figure 3.2).

2.2.6 Stage 6 – Evaluation of significance

The significance of a change in the landscape is a function of the magnitude of that change when considered against the view type/context and the sensitivity of a receptor. Typically, a noticeable change in the landscape in a rural or natural landscape, combined with a high visual sensitivity, would be considered to be significant, whereas a change in an already heavily modified landscape would be considered slight or moderate.

Table 2.3 illustrates how the magnitude of a change in the landscape is assessed, and its significance, rated against the sensitivity of a viewpoint.

Table 2.3 Evaluation of significance matrix

Magnitude of change	Visual sensitivity		
	High	**Moderate**	**Low**
High	Substantial	Moderate/ Substantial	Moderate
Moderate	Moderate/ Substantial	Moderate	Slight/ Moderate
Low	Moderate	Slight/ Moderate	Slight
Negligible	Slight	Slight	Negligible

Key: Significant Not significant

The primary assessment tools for determining the significance of impact of the project were the site inspection and photographs of the views from the selected viewpoints. This enabled an assessment of potential visual impact, taking into consideration the nature of the landscape, topography, the distance between the viewpoint and the proposed infrastructure, as well as the type of view experienced.

2.2.7 Stage 7 – Mitigation

The final step in the assessment process was to determine additional measures that could be incorporated into the design of the project to ameliorate, or, where possible, eliminate the visual impact of the proposed activity.

Mitigation measures can be in several forms including:

- design of project infrastructure to reduce the contrast with the surrounding environment;
- use of visual buffers and screening by planting vegetation; and
- designing infrastructure to screen operations and lighting.

Mitigation measures that have been incorporated into the design of the project are discussed in Section 4.8 of this report.

3 Site description

3.1 Description of the site

The site is within the Gunnedah Shire LGA in the Brigalow Belt South IBRA bioregion of northern NSW, approximately 12 km east of the township of Gunnedah (Figure 1.1). The site is divided by Orange Grove Road in to two portions, northern and southern, and encompasses an area of approximately 817 hectares (ha) (Figure 3.1).

The development footprint is defined as the land area within the site where project infrastructure will be constructed and operate for the project life. The development footprint encompasses an area of 253 ha within the 817 ha site. The development footprint has been refined through the project design process to avoid identified environmental constraints.

The site is zoned RU1 Primary Production under the Gunnedah LEP (Figure 3.2). It has been modified by past disturbances associated with land clearing, cropping, livestock grazing and weed invasion and is currently used for livestock grazing and cropping.

The project will connect to the TransGrid 132 kV electricity distribution network that feeds TransGrid's Gunnedah Substation, which, at its closest point, is approximately 4.2 km south-west of the site (Figure 3.1). TransGrid's 132 kV transmission line runs parallel to the southern boundary of the southern portion of the development footprint (Figure 3.1).

The site has suitable access to the local and regional road network including the Kamilaroi and Oxley Highways, Orange Grove Road and Kelvin Road (Figure 3.1).

Elevation across the site is relatively uniform at approximately 272–276 m Australian Height Datum (AHD). On a landscape scale, the site is part of an extensive floodplain of the Namoi River. Locally, the site is characterised by a landform pattern of mixed stagnant alluvial plains and features a single and continuous plain landform element.

3.2 Surrounding land uses

The site is part of the Namoi River catchment. Land use within this catchment is dominated by extensive agricultural operations, with grazing occupying 61.2% of the total catchment area (NSW Office of Water 2011). Dryland cropping and horticulture (16.2%), forestry (10.3%), native landscapes (5.1%), conservation (3.2%) and irrigation (3.0%) are also prevalent across the catchment area (NSW Office of Water 2011).

The site is in a semi-rural setting, with the wider region characterised by grazing, dryland and irrigation cropping properties, small-scale farm businesses, natural areas, scattered rural dwellings, villages and towns, mining and major transport infrastructure including the Oxley and Kamilaroi Highways.

The majority of the land surrounding the site is zoned RU1 primary production under the Gunnedah LEP (Figure 3.2). Land uses surrounding the site are predominantly agricultural and include both dryland and irrigated broad acre crop production and livestock grazing. The geography, climate, and environment within the Gunnedah Shire LGA are favourable for a variety of agricultural activities including the production of a variety of summer and winter crops (GSC 2014).

The Namoi Pistol Club is approximately 1.6 km from the north-eastern corner of the development footprint.

Somerton National Park is approximately 11 km south-east of the development footprint and covers an area of 759 ha (Figure 1.1). Melville Range Nature Reserve is approximately 22.5 km south-east of the development footprint and covers an area of 843 ha (Figure 1.1).

Frogmore Woolshed is approximately 3.7 km south-west of the development footprint at its closest point (Figure 3.1). Frogmore Woolshed is recognised as a place of local environmental heritage significance within the Gunnedah LEP. One of the objectives of the Gunnedah LEP is:

> to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views.

Views to the site from Frogmore Woolshed will be screened by existing vegetation within the landscape, the Oxley Highway and the Namoi River, which runs between the site and Frogmore Woolshed. Further, the relatively low height of the project's infrastructure will limit the potential for any views from this location.

No notable scenic or significant vistas within proximity of the site have been identified.

Siding Spring Observatory is approximately 130 km south-west of the development footprint. Siding Spring Observatory is Australia's most important visible-light observatory, on the edge of the Warrumbungle National Park. The development footprint is within the Dark Sky Region, which consists of land within a 200 km radius of Siding Spring Observatory. Further discussions of potential impacts from the project on the Siding Spring Observatory are provided in Section 3.8.

Photon Energy Generation Pty Ltd (Photon Energy) propose to construct the Gunnedah Solar Farm, a 155 MW PV solar farm approximately 3 km west of the development footprint (Figure 3.1), SEARs for which were issued by DPE on 25 August 2017. Cumulative visual impacts from the project and the Gunnedah Solar Farm are discussed in Section 5.6.

3.3 Electricity transmission infrastructure

As noted in Section 3.1, the project will connect to the TransGrid 132 kV electricity distribution network that feeds TransGrid's Gunnedah Substation, which, at its closest point, is approximately 4.2 km south-west of the development footprint (Figure 3.1). TransGrid's 132 kV transmission line is a prominent feature in the surrounding landscape and runs parallel to the southern boundary of the southern portion of the development footprint on the southern side of Orange Grove Road (Figure 3.1). Other lower voltage overhead wiring also runs through the northern portion of the site.

3.4 Rural dwellings

An investigation of aerial imagery of the site and its surrounds identified 13 potential rural dwellings within an approximate 3 km radius of the development footprint (Figure 3.1). Stands of scattered and more dense vegetation exist between the site and a number of these rural dwellings.

3.5 Settlements and townships

Gunnedah is the largest township in the Gunnedah Shire LGA with a population of 9,726 and is the region's commercial and administrative centre.

The town is approximately 12 km west of the development footprint (Figure 3.1). There are a range of retail, commercial, professional and personal services available within the town, as well as a number of accommodation options, which support the Gunnedah Shire LGA's strong visitor economy. Coal mining is the dominant industry of employment for the town of Gunnedah's population.

The village of Carroll, which has a population of approximately 337, is approximately 4.4 km south-east of the development footprint (Figure 3.2)

3.6 Traffic routes

The primary road transport route in the vicinity of the development footprint is Orange Grove Road (Figure 3.1). Orange Grove Road is a GSC rural road that traverses the landscape between Kelvin Road in the west and Keepit Dam Road in the east. Orange Grove Road primarily services local traffic and agricultural operations. At the site, Orange Grove Road is a single carriageway with an unsealed surface.

From Gunnedah, it is assumed that the majority of light vehicles would travel north along Chandos Street across Cohens Bridge and onto O'Keefe Avenue and Kelvin Road before turning onto Orange Grove Road. Due to the width restriction on Cohens Bridge, it is proposed that all project-related heavy vehicles will follow an alternate route. This would involve turning off the Kamilaroi Highway onto Blue Vale Road, 4 km north-west of Gunnedah, and then turning onto Old Blue Vale Road before rejoining Kelvin Road, thereby bypassing Cohens Bridge.

Orange Grove Road has been considered as part of this VIA as motorists travelling along this road corridor will have views of the project.

As part of the site inspection, observations were made from the development footprint towards the Oxley Highway. Due to distance from the development footprint, the Namoi River and associated riparian vegetation, presence of remnant vegetation, and relatively low height of the project infrastructure, views of the project are unlikely for motorists travelling east and west along the Oxley Highway.

3.7 Air traffic

The Gunnedah Airport is approximately 12 km west of the development footprint (Figure 3.1). In addition, Lake Keepit Aircraft Landing Area (ALA) is approximately 13 km north-east of the development footprint (Figure 1.1).

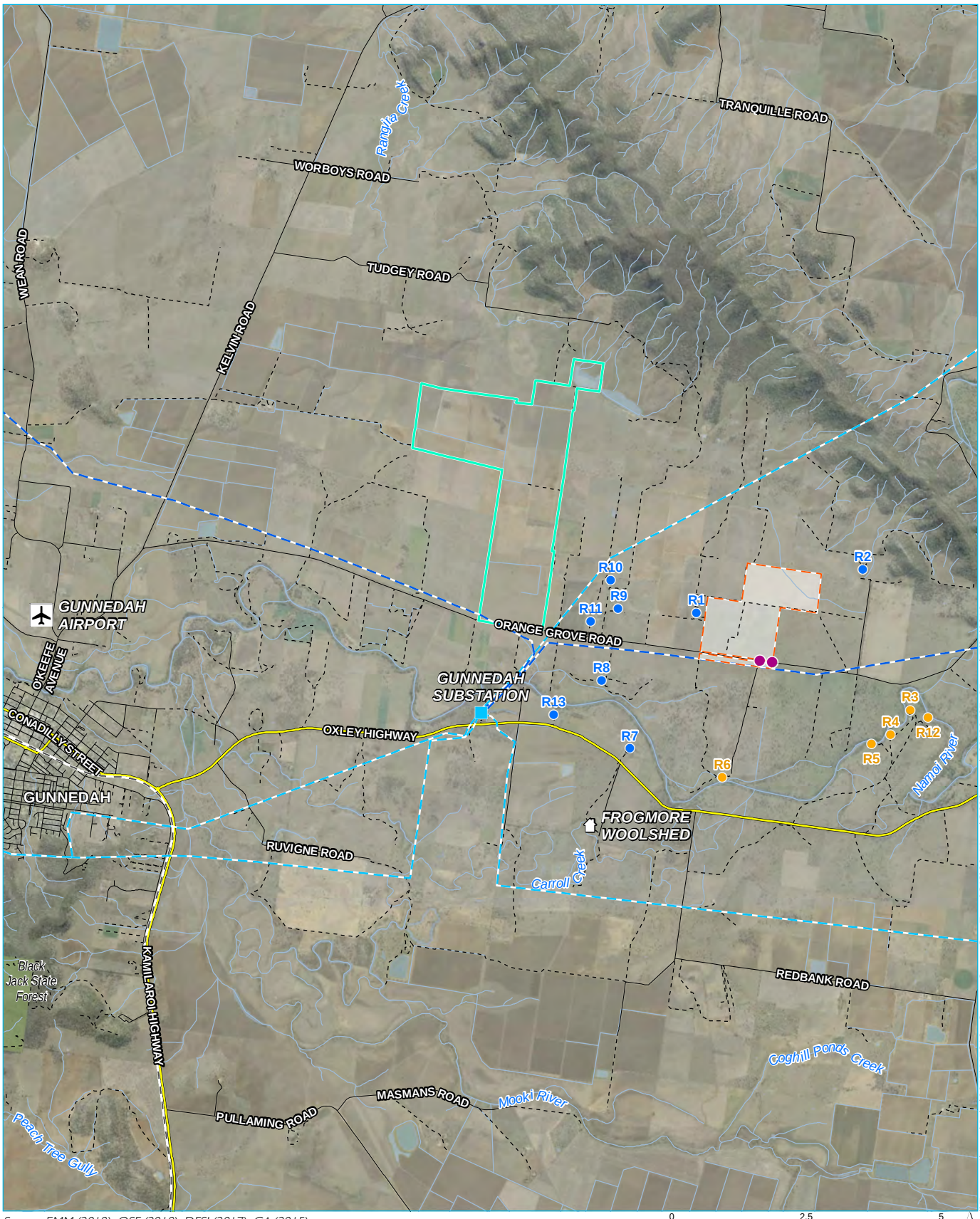
3.8 Night lighting

Existing sources of night lighting in the immediate vicinity of the development footprint are minimal due to its rural setting. The main sources of lighting would be from rural residential properties, farm machinery and vehicles on roads. The headlamps from vehicles travelling east-west along Orange Grove Road would provide a modest source of lighting in the evening and night time hours.

The project will not require permanent night lighting. Temporary, localised night lighting may be required during general maintenance activities conducted during the operation stage of the project. If required, lighting will be managed to minimise impacts on surrounding areas.

The development footprint is within the Dark Sky Region of NSW, centred upon Siding Spring Observatory. Good lighting design within the Dark Sky Region supports the ongoing successful functioning of the Siding Spring Observatory.

The *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring* (DPE 2016b) demonstrates how light from development can be managed to reduce impacts on the operation of the Siding Spring Observatory. Temporary, localised night lighting for the project will be installed in accordance with the good lighting design principles listed within the *Dark Sky Planning Guideline* (DPE 2016b), which include directing light downwards, using shielded fittings, avoiding 'over' lighting, switching lights off when not required, and using energy efficient light bulbs.



Source: EMM (2018); OSF (2018); DFSI (2017); GA (2015)

0 2.5 5 km

GDA 1994 MGA Zone 56

N

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KEY

- Development footprint
- Indicative site access point
- Gunnedah Solar Farm (SSD 8658 - proposed by Photon Energy Generation Pty Ltd)*

Receptors

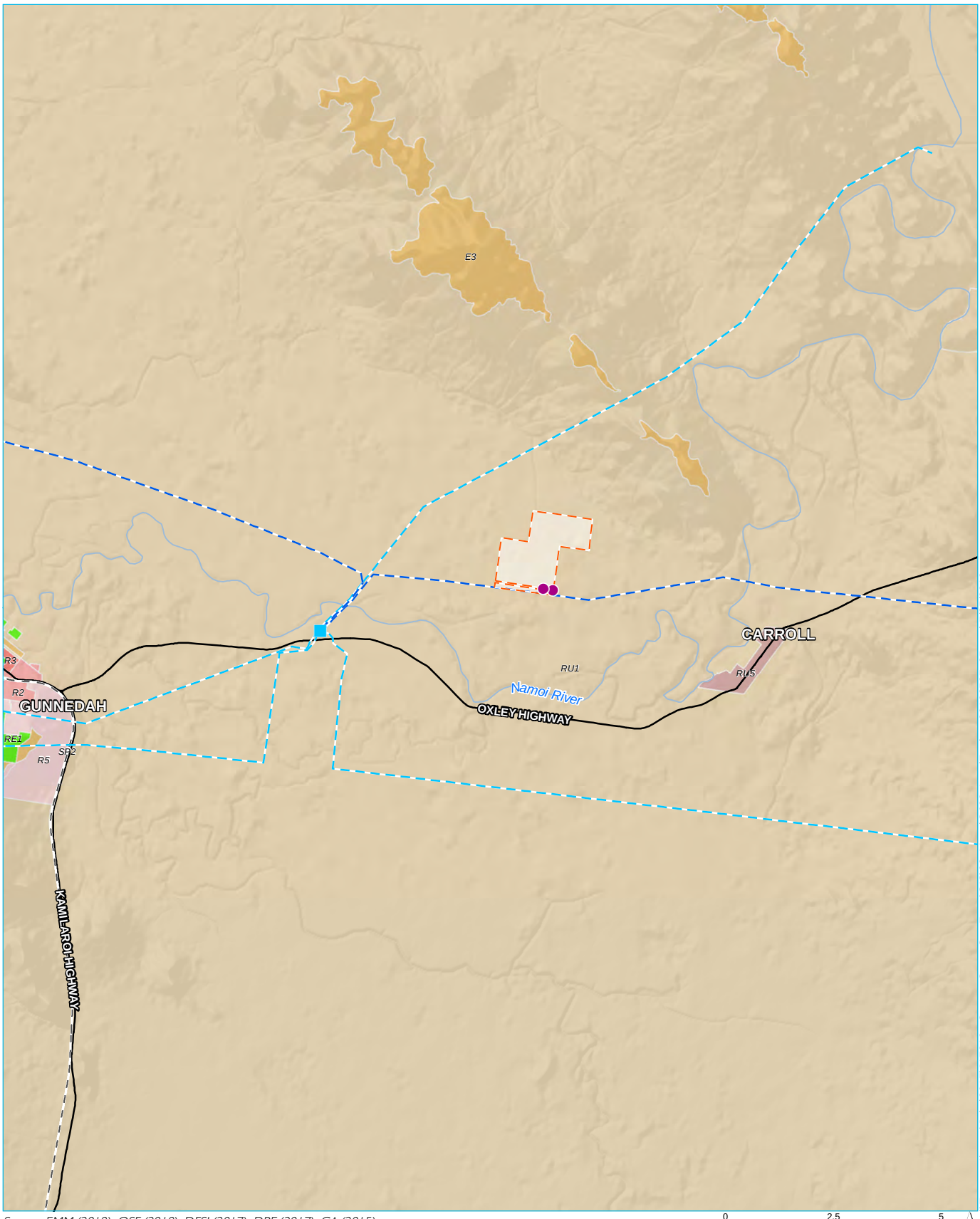
- Non project-related receptors
- Project-related receptor
- 132 kV transmission line
- 66 kV transmission line
- Rail line
- Main road
- Local road
- Vehicular track
- Watercourse / drainage line
- Waterbody
- State forest

Location of the Orange Grove Sun Farm

Orange Grove Sun Farm
Visual impact assessment
Figure 3.1

EMM

** DPE 2017, Gunnedah Solar Farm, viewed 11 October 2017, http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=8658*



Source: EMM (2018); OSF (2018); DFSI (2017); DPE (2017); GA (2015)

0 2.5 5 km

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KEY

- Development footprint
- Indicative site access point
- Gunnedah Substation
- 132 kV transmission line
- 66 kV transmission line
- Rail line
- Main road
- Namoi River

Land use zone

- E3 Environmental Management
- R2 Low Density Residential
- R3 Medium Density Residential
- R5 Large Lot Residential
- RE1 Public Recreation
- RU1 Primary Production
- RU5 Village
- SP2 Infrastructure

Land use zoning

Orange Grove Sun Farm
Visual impact assessment
Figure 3.2

EMM

4 Visual elements of the project

4.1 Development footprint

The development footprint within the site boundary (Figure 3.1) has been refined on the basis of grid connection studies, environmental constraints identification and design of project infrastructure.

OVERLAND has designed the project based on its experience in leading benchmark renewable energy and infrastructure projects. The site location, capacity of the project, design and layout of infrastructure and connection to the electricity grid have been refined through an evaluation process both prior to and during preparation of this VIA and the associated EIS. The evaluation process has considered a range of factors, including:

- availability of solar radiation;
- proximity to, and capacity of the electricity grid;
- availability of sufficient land area with suitable physical characteristics;
- identification and avoidance of environmental constraints; and
- placement of infrastructure to minimise land use conflicts with landholders.

Specifically, the parcels of land that comprise the development footprint (as defined in Section 3.1), and the placement of infrastructure including solar panels, inverters, electrical collection system and switchyard and connection infrastructure, have been identified through consultation with the landholders and receptors, to minimise visual impacts and land use conflicts and enable agricultural production and land management practices to continue on surrounding land.

The development footprint consists of a northern (239 ha) and southern (14 ha) portion and is divided by Orange Grove Road. The only project infrastructure proposed for the southern portion of the development footprint is to facilitate the connection of the project to TransGrid's 132 kV transmission line (Figure 4.1). Subsequently, visual impacts on the surrounding locality from the construction of project infrastructure in the southern portion of the development footprint will be limited.

4.2 Site preparation

Due to the development footprint's flat terrain and predominantly cleared landscape, limited site preparation and civil works will be required. Site establishment works and preparation for construction will include:

- the establishment of a temporary construction site compound in a fenced off area within the development footprint including:
  - a site office;
  - containers for storage; and
  - parking areas;
- removal of above and below ground level irrigation structures;

- construction of access tracks and boundary fencing;
- site survey to confirm infrastructure positioning and placement; and
- where necessary, additional geotechnical investigations to provide information specific to the selected tracking system, mountings, and foundation pile arrangement.

The site establishment works and preparation for construction outlined above are unlikely to result in significant visual impacts due to their temporary nature.

4.3 Construction

Upon completion of the site establishment and pre-construction activities described above, construction will typically be as follows:

- posts will be driven or screwed into the ground to provide support for the mounting framework required for the PV solar panels;
- foundations for the inverter blocks, switchyard and management hub structures will be prepared;
- underground cabling will be installed between the PV solar panels and the collection circuit (this cabling will carry power throughout the site, between the inverters and central electrical switchyard, which will be located in the management hub);
- PV solar panel frames will be assembled and mounted on top of the posts;
- PV solar panels, inverters, transformers and switchgear units will be installed;
- connection infrastructure between the project electrical switchyard and TransGrid's 132 kV transmission line will be constructed;
- the management hub will be constructed;
- permanent fencing and security will be constructed within the northern portion of the development footprint; and
- the temporary construction site compound will be removed.

As noted previously, the project may include the installation of battery and energy storage devices within a secure compound within the development footprint. The rated capacity of future battery and energy storage devices has not been determined at this stage of project development. The inclusion of such energy storage devices will be determined during the detailed design stage of the project and will be dependent on network integration and commercial considerations. A modification to the consent would be sought to permit the installation of this infrastructure within the development footprint if required.

The construction stage of the project will take approximately nine months from the commencement of site establishment works and will result in a number of physical changes to the landscape, namely through the installation of infrastructure, the components of which are described in detail below.

4.4 PV solar panels

The project involves the installation of PV solar panels, arranged in a series of rows positioned to maximise the use of the solar resource available at the site (refer to Photograph 4.1). Approximately 330,000 PV solar panels could be accommodated within the development footprint. The final number of PV solar panels within the development footprint will be dependent on detailed design, and availability and commercial considerations at the time of construction.

PV solar panels will be constructed in a single axis tracking configuration, and will be fixed to and supported by ground-mounted framing (refer to Photograph 4.2). This configuration will allow the PV solar panels to rotate from east to west during the day, tracking the sun's movement. The average height of the PV solar panel rows will be approximately 1.2 m. During the early morning and late afternoon tracking periods, the maximum height of the PV solar panel rows will be approximately 2.4 m.

The NSW Department of Planning and Environment – Division of Resources and Energy (DPE-DRE) (2016) states that solar farms are not considered to be reflective. To maximise the efficiency of the electricity production process, PV solar panels are designed to absorb as much light as possible.

One of the primary goals of PV solar panel design, manufacture and installation is to minimise the amount of light reflected. PV solar panels will be constructed of solar glass with an anti-reflective coating.

Photograph 4.1 Example of the proposed PV solar panel array layout with inverters

Photograph 4.2 **Example of the steel frame structures with a single axis tracking system used to support PV solar panels**

4.5 Battery and energy storage

The project may include the installation of battery and energy storage devices within a secure compound within the development footprint. The rated capacity of future battery and energy storage devices has not been determined at this stage of project development. The inclusion of such energy storage devices will be determined during the detailed design stage of the project and will be dependent on network integration and commercial considerations. A modification to the consent would be sought to permit the installation of this infrastructure within the development footprint if required.

The purpose of the battery and energy storage devices would be to store energy on-site, which will allow energy to be released at specific times. The battery and energy storage devices would also provide a number of network services, including frequency control integration and energy arbitrage, as well as improved reliability of electricity provision from the project. Energy arbitrage allows energy to be stored on-site during periods of low demand and then be discharged into the network during periods of greater demand.

4.6 Connection infrastructure

TransGrid's 132 kV transmission line runs parallel to the southern boundary of the southern portion of the development footprint (Figure 3.1). The infrastructure required for connection to the local electricity distribution network between the development footprint and TransGrid's 132 kV transmission line will be dependent on the requirements of the network service provider, outcomes of grid connection studies (which are currently in progress), transmission line route selection and engineering, environmental and landholder constraints.

4.7 Access, parking and security

Access to the northern and southern portions of the development footprint will be via Orange Grove Road (Figure 4.1). The predicted additional daily traffic generated at the peak stage of project construction will be approximately 116 daily vehicle movements, reducing to approximately 80 daily vehicle movements during the earlier and later (average) stages of project construction, and approximately 10 daily vehicle trips during the operational stage of the project. Further information about projected vehicle movements to and from the site throughout the project's construction and operation are available in Appendix I of the EIS.

Internal access roads of approximately 4–6 m width will be constructed to accommodate construction and operational traffic movements throughout the development footprint. The indicative location of the access roads is illustrated in the detailed infrastructure layout plan (Figure 4.1).

During construction, a suitable number of parking spaces will be available within the temporary construction compound.

The northern portion of the development footprint will be fenced off by a chain mesh fence, which will be approximately 1.8–2.4 m high. Fencing will restrict public access to the northern portion of the development footprint. No additional fencing is proposed for the southern portion of the development footprint.

4.8 Mitigation of visual impacts

Development of the design has included general measures to reduce the degree of contrast between the project and the surrounding rural landscape, having regard to the form, scale, height, colour and texture of materials incorporated as part of the project's infrastructure. All of these amendments have reduced the overall visual impacts. This assessment has led to further refinement of the project to reduce visual impacts through consultation with surrounding landholders.

4.8.1 Landscaping

A conceptual landscaping plan is provided in Figure 4.2, which presents landscaping options along the closest boundary of the development footprint to receptors R1 and R2. The proposed landscaping along the western boundary of the development footprint immediately adjacent to R1 would reduce the visibility of project infrastructure from R1. The proposed landscaping along portions of the northern and eastern boundaries of the development footprint would further reduce the visibility of project infrastructure from R2.

The final location and extent of landscaping will be determined during detailed design and following subsequent discussions with the project landowners and the property owners of R1 and R2 as part of preparation of the environmental management plan (EMP). Landscaping would involve planting of native shrub species between 1-3 m in height with a screening canopy height of 4-5 m. A suggested species list is provided in Table 4.1.

Table 4.1 Suggested native shrub species for landscaping

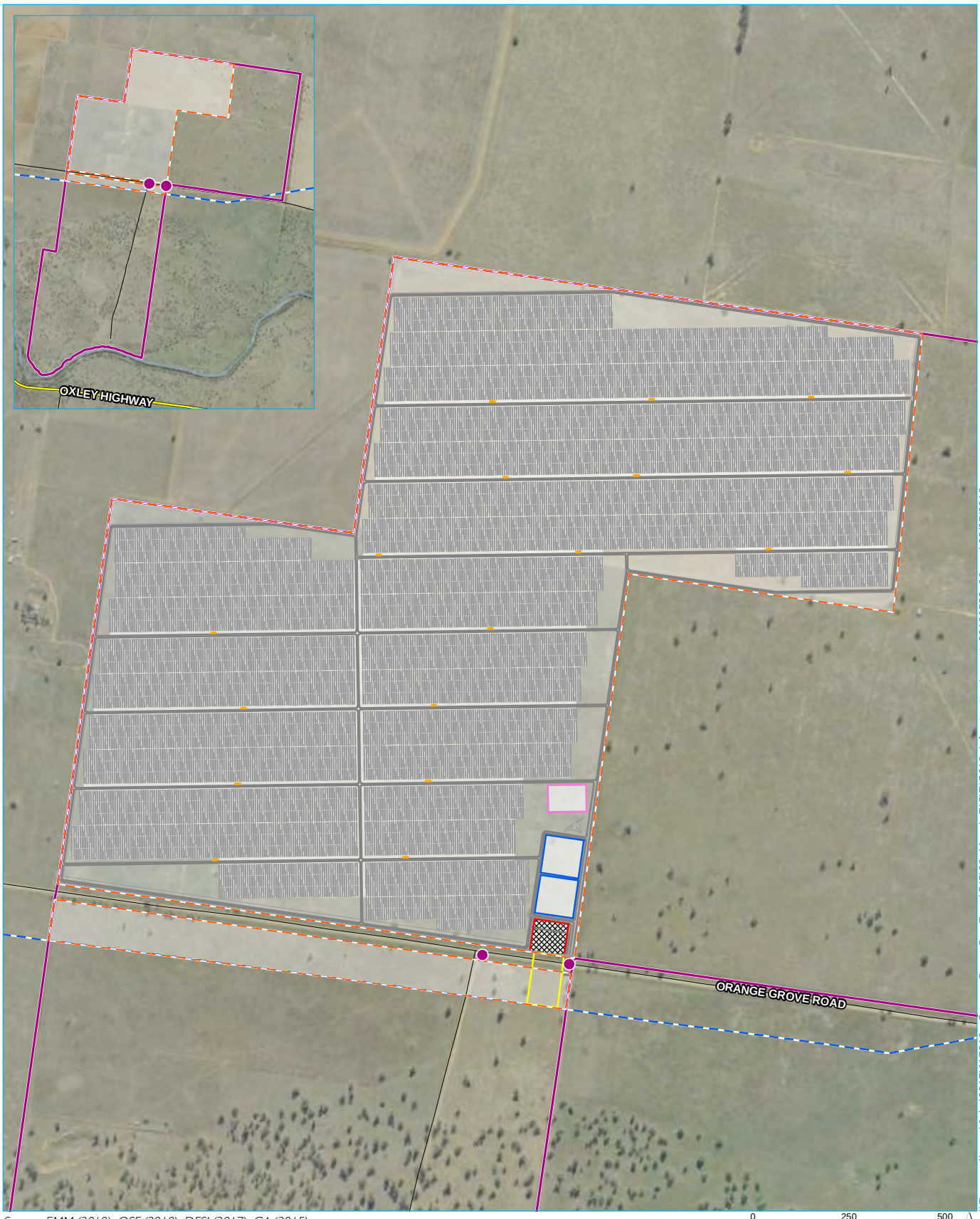
Scientific name	Common name	Suggested planting spacing
Eucalyptus populnea	Bimble Box	6 m
Brachychiton populneus	Kurrajong	6 m
Acacia harpophylla	Brigalow	6 m
Acacia pendula	Weeping Myall	2-3 m
Acacia salicina	Cooba Wattle	2-3 m

4.8.2 Colour of materials

Suitable colours will be chosen for project infrastructure to minimise visual impacts. Buildings and materials for site amenities will be made from colourbond or similar. These buildings and materials will be designed to blend in with the local farming landscape and will not be dissimilar to existing farm sheds located in the surrounding area.

4.8.3 Night lighting

As noted in Section 3.8, the project will not require permanent night lighting. Temporary, localised night lighting may be required during general maintenance activities conducted during the operation stage of the project. If required, lighting will be managed to minimise impacts on surrounding areas.



Source: EMM (2018); OSF (2018); DFSI (2017); GA (2015)

0 250 500 m
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N

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KEY

- Orange Grove Sun Farm site boundary
- Development footprint
- Area to be subdivided
- Indicative site access point
- 132 kV transmission line
- Local road

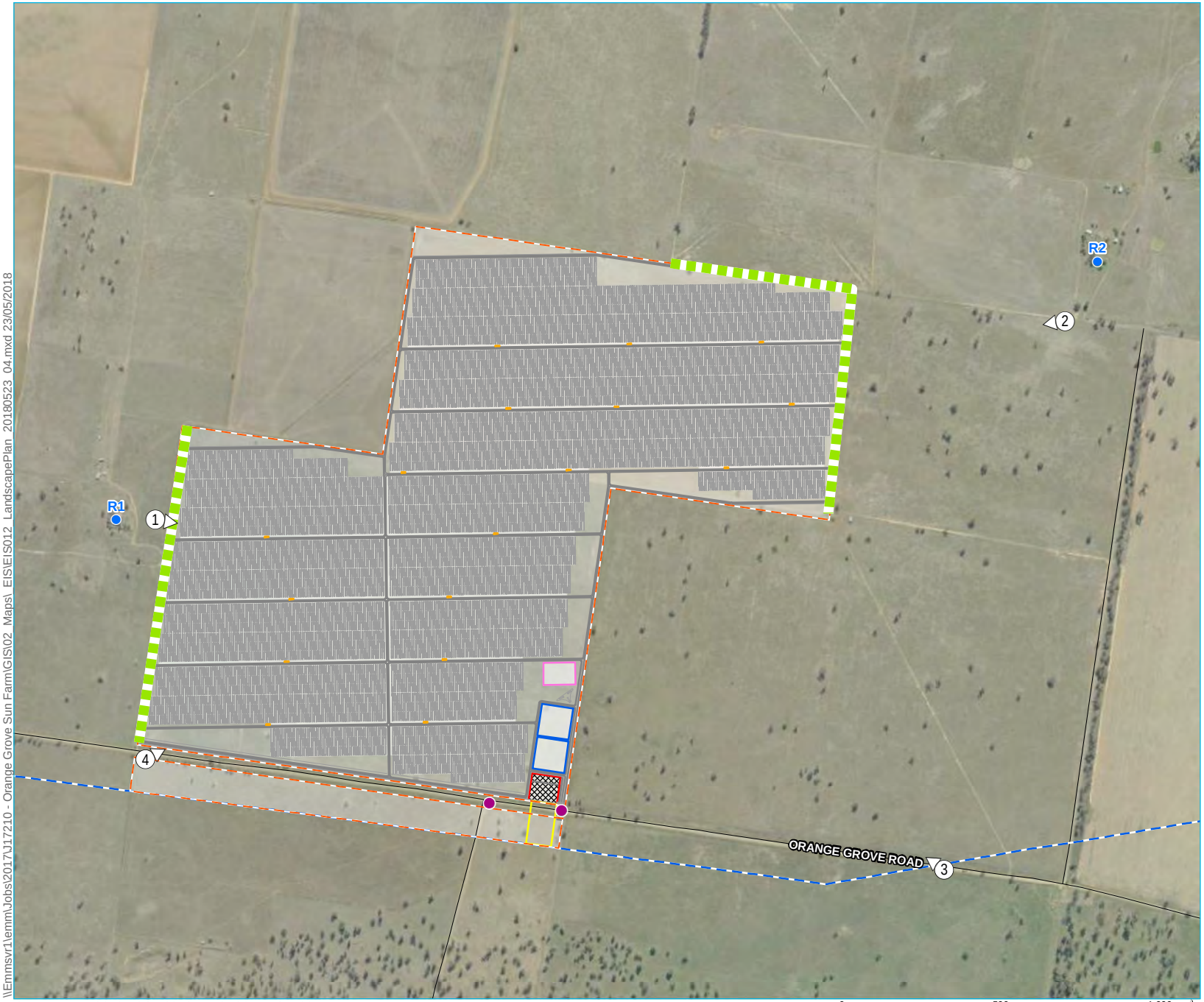
Project infrastructure

- Solar panel layout
- Internal road
- Management hub and potential future battery storage
- On-site switchyard and transformation area
- Inverter
- Temporary laydown area
- Transmission corridor

Infrastructure layout plan

Orange Grove Sun Farm
Visual impact assessment
Figure 4.1

EMM



KEY

- Development footprint
- Area to be subdivided
- Indicative site access point
- 132 kV transmission line
- Main road
- Local road
- Non project-related receptors
- Viewpoint location and number

Project infrastructure

- Solar panel layout
- Internal road
- Management hub and potential future battery storage
- On-site switchyard and transformation area
- Inverter
- Temporary laydown area
- Transmission corridor
- Area of proposed landscaping (not to scale)

Source: EMM (2018); OSF (2018); DFSI (2017); GA (2015)

0 500 1,000 m

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Conceptual landscaping plan

Orange Grove Sun Farm
Visual impact statement
Figure 4.2

EMM

5 Visual assessment

5.1 Assessed viewpoints

Following the desktop analysis, a site inspection was undertaken on 18 January 2018 to ground-truth the identified representative viewpoints and photograph the site from these representative viewpoints. Viewpoints were selected based on:

- proximity to the site and, more specifically, the project's development footprint;
- the location of receptors (ie dwellings);
- the positioning of road corridors and potential impacts on passing motorists;
- local topography; and
- existing vegetation screening.

The locations of the six viewpoints are illustrated in Figure 5.1. The rationale for the selection of each of the viewpoints analysed are summarised in Table 5.1.

Table 5.1 Assessed viewpoints and receptors

Assessment location	Viewpoint type	Rationale for selection
Viewpoint 1	Dwelling	Views are representative of a receptor (ie dwelling) west of the site, R1, approximately 150 m from the development footprint's western boundary (Figure 5.2).
Viewpoint 2	Dwelling	Views are representative of a receptor (ie dwelling) north-east of the site, R2, approximately 760 m from the development footprint's north-eastern boundary (Figure 5.2).
Viewpoint 3	Motorists	Views are representative of those experienced by motorists travelling west along Orange Grove Road. Views of project infrastructure are likely for a distance of approximately 2.5 km travelling west from this location. Assuming that motorists are travelling at the prescribed speed limit of 100 km/h, this would result in a length of exposure of approximately 90 seconds for motorists travelling west. Daily traffic estimates indicate that approximately 89 vehicles travel along the unsealed section of Orange Grove Road per day (refer to Appendix I of the EIS).
Viewpoint 4	Motorists	Views are representative of those experienced by motorists travelling east along Orange Grove Road. Views of project infrastructure are likely for a distance of approximately 1.3 km travelling east from this location. Assuming that motorists are travelling at the prescribed speed limit of 100 km/h, this would result in a length of exposure of approximately 47 seconds for motorists travelling east. Daily traffic estimates indicate that approximately 89 vehicles travel along the unsealed section of Orange Grove Road per day (refer to Appendix I of the EIS).

Table 5.1 Assessed viewpoints and receptors

Assessment location	Viewpoint type	Rationale for selection
Viewpoint 5	Motorists Dwellings	Views are representative of receptors (ie dwellings) to the west of the development footprint off Orange Grove Road (Figure 5.2): R8 – 1.8 km; R9 – 1.6 km; R10 – 1.8 km; and R11 – 2.1 km. Views are also considered representative of those experienced by motorists travelling east along Orange Grove Road, west of the development footprint. Daily traffic estimates indicate that approximately 89 vehicles travel along the unsealed section of Orange Grove Road per day (refer to Appendix I of the EIS). This viewpoint was selected on the basis that motorists travelling along this road corridor may experience limited views of project infrastructure at this location. This viewpoint is approximately 1.1 km east of the proposed development footprint for the Gunnedah Solar Farm.
Viewpoint 6	Motorists	Views are representative of those experienced by motorists travelling west along Orange Grove Road. Daily traffic estimates indicate that approximately 89 vehicles travel along the unsealed section of Orange Grove Road per day (refer to Appendix I of the EIS). This viewpoint was selected on the basis that motorists travelling along this road corridor may experience limited views of project infrastructure at this location.

5.2 Construction impacts

A description of the site establishment and construction activities associated with the project is provided in Chapter 4.

As noted in Section 4.2, due to the development footprint's flat terrain and predominantly cleared agricultural landscape, limited site preparation and civil works will be required.

There are no PV solar panels proposed to be installed in the southern portion of the development footprint, south of Orange Grove Road. Subsequently, the most significant visual impacts during the construction stage of the project will be experienced by receptors with views of the northern portion of the development footprint.

During construction, the landscape within the development footprint will undergo a number of physical changes, namely through the installation of project infrastructure, which will add new features to the site's visual landscape.

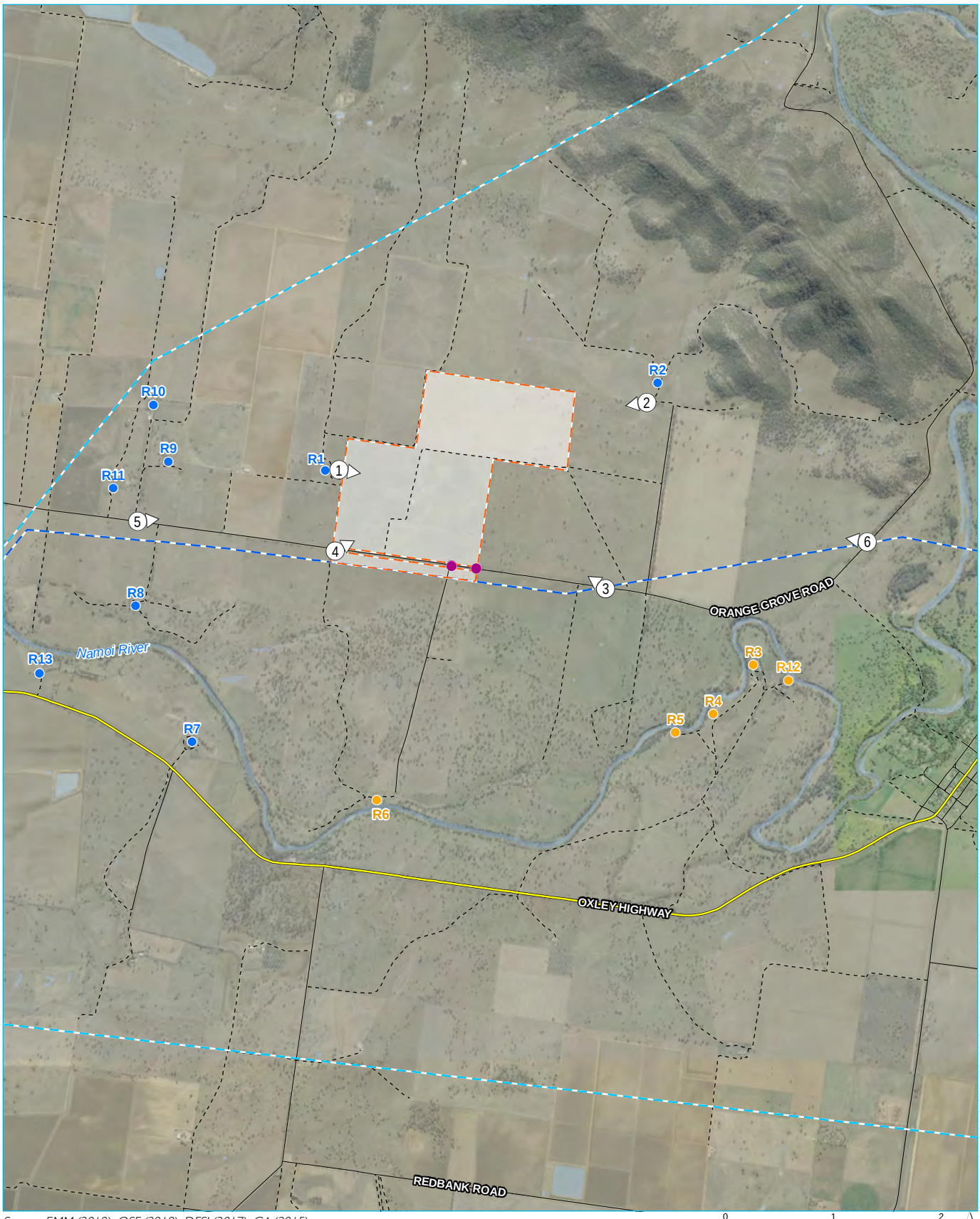
Motorists travelling along Orange Grove Road will experience views of the development footprint during construction. It is assumed the focus of these motorists will be in line with their direction of travel along this road corridor. In addition, views of the northern portion of the development footprint during construction will also be possible from R1 and R2, respectively.

Due to their temporary nature (ie approximately nine months), the site establishment works and construction activities are considered unlikely to have any significant visual impacts on passing motorists or nearby receptors. Subsequently, landscaping is not proposed to mitigate visual impacts during the construction stage of the project.

As noted in Section 4.8.1, landscaping is proposed to mitigate the visual impact of the project at R1 and R2 prior to the commencement of operations (Figure 4.2). The final location and extent of landscaping will be determined during detailed design and following subsequent discussions with the project landowners and the property owners of R1 and R2 as part of preparation of the EMP. It is proposed that this landscaping will be effective at screening views of the project infrastructure from R1 and R2 within three years of the commencement of construction.

Views of the northern portion of the development footprint during construction may also be possible from the Namoi Pistol Club. The Namoi Pistol Club is not within a sensitive land use zone (refer to Table 2.1). Further, the visual sensitivity of the Namoi Pistol Club has been assessed as low as it has been considered to be a low concern viewpoint. Consultation with the Namoi Pistol Club has been undertaken as part of the preparation of the EIS for the project (refer to Chapter 5 and Appendix B of the EIS). The results of this consultation confirmed that the pistol range is aligned north to south, with members firing to the north and therefore no visual screening would be required as the changes to the visual landscape are not considered significant due to the low visual sensitivity of the Namoi Pistol Club and 1.6 km distance from the development footprint.

No additional mitigation measures during the site establishment and construction activities are warranted.



Source: EMM (2018); OSF (2018); DFSI (2017); GA (2015)

0 1 2 km
GDA 1994 MGA Zone 56

N

KEY

- Development footprint
- Indicative site access point
- 132 kV transmission line
- 66 kV transmission line
- Main road
- Local road
- Vehicular track
- Waterbody
- Viewpoint location and number

Receptors

- Non project-related receptors
- Project-related receptor

Viewpoint locations

Orange Grove Sun Farm
Visual impact assessment
Figure 5.1

EMM

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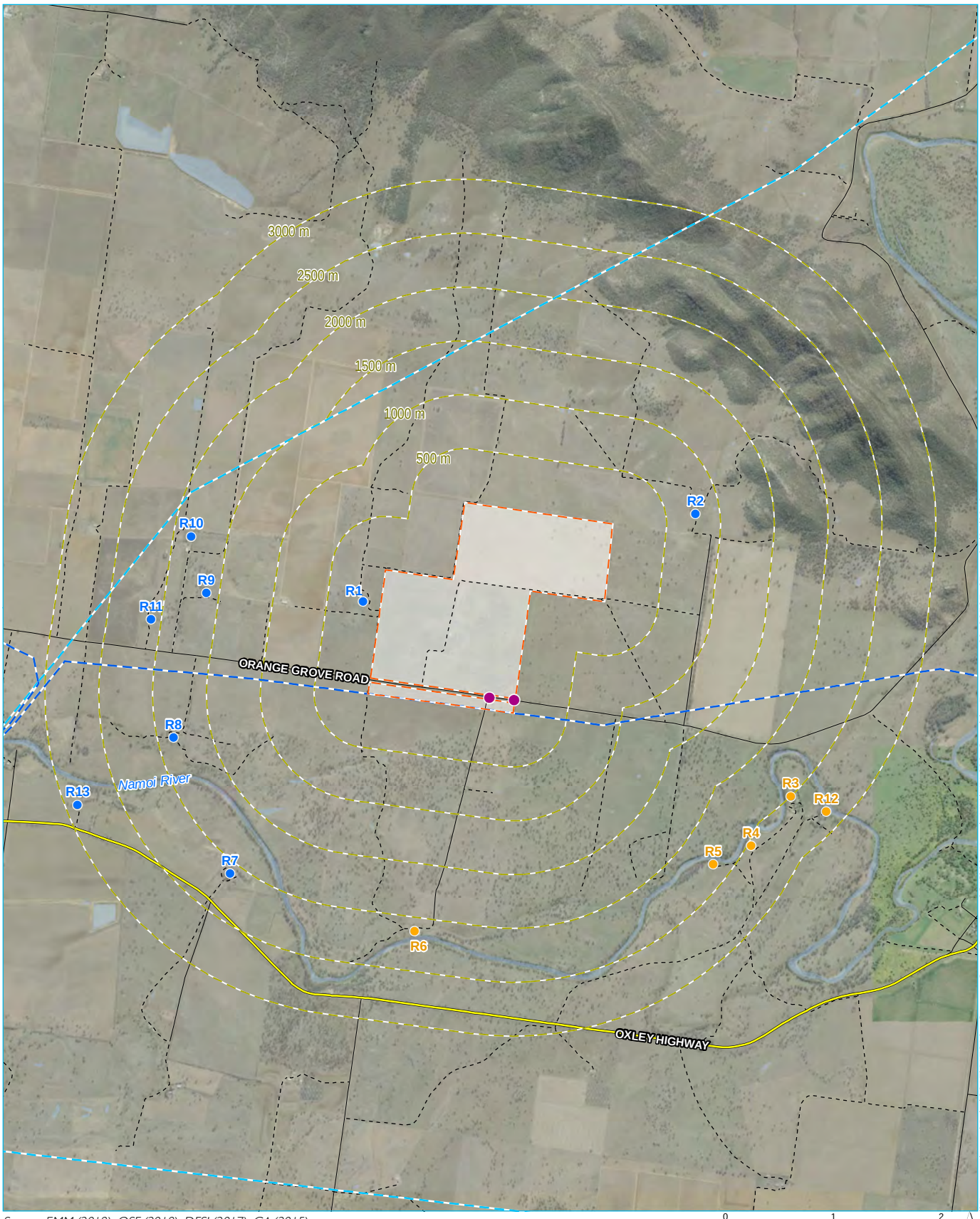

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Source: EMM (2018); OSF (2018); DFSI (2017); GA (2015)

0 1 2 km

GDA 1994 MGA Zone 56

N

KEY

- Development footprint
- Indicative site access point
- 132 kV transmission line
- 66 kV transmission line
- Main road
- Local road
- Vehicular track
- Distance buffer (500 m increments)
- Waterbody

Receptors

- Non project-related receptors
- Project-related receptor

Location of receptors

Orange Grove Sun Farm
Visual impact assessment
Figure 5.2

EMM

5.3 Operation impacts

An assessment of the selected viewpoints in accordance with the methodology outlined in Chapter 2 of this report is presented in the following sections.

5.3.1 Viewshed analysis

To determine potential visibility of project infrastructure, a viewshed analysis was completed. The results of the viewshed analysis are presented in Figure 5.3, which identifies the likely changes to the viewshed experienced at each viewpoint as a result of the installation of the project infrastructure within the development footprint.

The construction and operation of the project within the development footprint will result in one of two changes to the existing viewshed experienced at each viewpoint, namely loss of viewshed (ie features of the existing landscape will no longer be visible due to project infrastructure) and gain of viewshed (ie parts of the landscape will become more visible due to project infrastructure) (refer to Figure 5.3).

The viewshed analysis simulates the effects of topography and distance on screening views of project infrastructure and takes into account the height of the dominant project infrastructure, ie the PV solar panels. As part of the viewshed analysis, the height of the PV solar panels was conservatively assumed to be 2.4 m. The results of the viewshed analysis indicate that project infrastructure will be visible to varying degrees from each of the six viewpoints assessed as part of this VIA. In addition, the project will result in changes to the visibility of existing features within the landscape. As highlighted in Figure 5.3, viewpoints 1, 2 and 4 will likely experience the greatest loss of existing viewshed as a result of the project.

Due to the scattered nature of remnant vegetation within the landscape surrounding the development footprint, the effects of existing vegetation in screening views of project infrastructure have not been considered as part of the viewshed analysis. However, based on aerial imagery and ground truthing, the majority of the rural residential dwellings surrounding the site feature extensive vegetation screens on their boundaries. These screens would mitigate dust and noise impacts from existing agriculture-related activities on land adjacent to these dwellings. A key observation made during the site inspection conducted on 18 January 2018 was that the presence of vegetation screens as well as stands of both scattered and more dense vegetation between the site and a number of rural dwellings means that views to the development footprint are typically at least partially obstructed from most locations, with the exception of views of the development footprint from passing motorists travelling along Orange Grove Road. Examples of vegetation screening around nearby receptors (ie dwellings) are provided in Photograph 5.2 (R1) and Photograph 5.4 (R2).

Project infrastructure in the northern portion of the development footprint may also be visible from the Namoi Pistol Club. As discussed in Section 5.2, consultation with the Namoi Pistol Club has been undertaken as part of the preparation of the EIS for the project (refer to Chapter 5 and Appendix B of the EIS). The results of this consultation confirmed that no visual screening would be required as the changes to the visual landscape are not considered significant due to the low visual sensitivity of the Namoi Pistol Club and distance to the development footprint. As part of this consultation, some concerns were raised about potential reflectivity and glare impacts on recreational users of the Namoi Pistol Club. Reflectivity and glare are discussed in detail in Section 5.4.

As noted above, a number of nearby receptors (ie dwellings) are shielded from views of the project infrastructure to some degree by vegetation immediately surrounding each of the dwellings and/or remnant vegetation between the development footprint and these dwellings.

5.3.2 Viewpoint 1 – dwelling west of the development footprint looking east towards the development footprint

Table 5.2 Viewpoint 1 – dwelling west of the development footprint looking east towards the development footprint

Viewpoint details	This viewpoint, shown in Photograph 5.1, is within proximity of the closest private rural residential property to the site's western boundary (R1 in Figure 5.2). Photograph 5.1 was taken from the western boundary of the development footprint looking east in to the northern portion of the development footprint. The view direction in the photograph is to the east. Photograph 5.2 was also taken on the western boundary of the development footprint looking west towards R1. R1 is approximately 150 m from the western boundary of the development footprint. The view direction in the photograph is to the west. As part of the site inspection in January 2018, access to R1 was not possible. Subsequently, the location of Viewpoint 1 was selected as it was considered to be representative of potential views of project infrastructure from R1.
View type and context	Immediate views from this location represent a typical rural setting with a predominantly flat expanse of cleared, agricultural land. As seen in Photograph 5.1, a prominent visual feature at this location is an existing power line, which traverses the development footprint. Scattered remnant vegetation increases in density in the background leading to rolling hills east of the Oxley Highway at Carroll. From this viewpoint, it is apparent that R1 has a significant level of vegetation along its eastern boundary, which would likely screen some views of the project infrastructure from this dwelling (refer to Photograph 5.2). Nonetheless, views directly east towards the project infrastructure will be possible from this viewpoint.
Visibility baseline assessment	The results of the viewshed analysis indicate that the project will result in the loss of viewshed visible from this viewpoint with features of the existing landscape no longer visible due to project infrastructure (Figure 5.3). However, as noted in Section 5.3.1, the viewshed analysis performed as part of this VIA did not take in to account the effects of existing vegetation in screening views of project infrastructure from this location.
Magnitude of change	**High** –as a result of its close proximity to the development footprint, R1 will be exposed to views of project infrastructure. Although a significant level of vegetation was observed along the eastern boundary of this property, this vegetation is unlikely to provide a sufficient level of mitigation to reduce the significance of the visual impacts experienced from this viewpoint during the operation of the project. The project infrastructure will add new features to the visual landscape at this location, which will result in a high degree of contrast to the surrounding rural setting.
Visual sensitivity	**Moderate** – due to the presence of a rural dwelling.
Evaluation of significance	**Substantial –** without additional mitigation, the operation of the project would result in a significant visual impact from this viewpoint. Without mitigation, visual impacts from this viewpoint would continue throughout the life of the project.
Additional mitigation	A conceptual landscaping plan is shown in Figure 4.2, which presents the option for landscaping along the western boundary of the northern portion of the development footprint. This landscaping will reduce the visibility of project infrastructure from R1.

Photograph 5.1 Viewpoint 1 – dwelling west of the development footprint looking east towards the development footprint

Photograph 5.2 Viewpoint 1 – dwelling west of the development footprint

5.3.3 Viewpoint 2 – dwelling north-east of the development footprint looking south-west towards the development footprint

Table 5.3 Viewpoint 2 – dwelling north-east of the development footprint looking south-west towards the development footprint

Viewpoint details	This viewpoint, shown in Photograph 5.3, is within proximity of the closest private rural residential property to the development footprint's north-eastern boundary (R2 in Figure 5.2). Photograph 5.4 was taken from the northern boundary of the site looking south-west in to the northern portion of the development footprint. The view direction in the photograph is to the south-west. Photograph 5.4 was also taken on the northern boundary of the site looking north towards R2. R2 is approximately 760 m from the north-eastern corner of the northern portion of the development footprint. The view direction in the photograph is to the north. As noted above, this photograph was taken from the northern boundary of the site. No project infrastructure is proposed at this location. As part of the site inspection in January 2018, access to R2 was not possible. Subsequently, the location of Viewpoint 2 was selected as it was considered to be representative of potential views of project infrastructure from R2. No project infrastructure is proposed outside of the development footprint. At Viewpoint 2, the closest project infrastructure will be constructed approximately 760 m west within the northern portion of the development footprint. Further, as noted above, the closest project infrastructure to R2 will be approximately 760 m south-west of the residence within the northern portion of the development footprint.
View type and context	Immediate views from this location represent a typical rural setting with a predominantly flat expanse of cleared, agricultural land. Scattered remnant vegetation increases in density in the background. From this viewpoint, it is apparent that R2 has a significant level of vegetation along its southern boundary, which would likely screen the majority of views of the project infrastructure from this dwelling (refer to Photograph 5.4). Nonetheless, views south-west towards the project infrastructure within the development footprint may be possible from this viewpoint.
Visibility baseline assessment	The results of the viewshed analysis indicate that the project will result in the loss of viewshed visible from this viewpoint with features of the existing landscape no longer visible due to project infrastructure (Figure 5.3). However, as noted in Section 5.3.1, the viewshed analysis performed as part of this VIA did not take in to account the effects of existing vegetation in screening views of project infrastructure from this location. Based on the site inspection, consultation with the landholders at R2 and the results of the viewshed analysis, project infrastructure is predicted to be visible from this viewpoint. As part of consultation with the landholders at R2 and subsequent to the site inspection performed in January 2018, permission was granted to obtain photos from the residence at R2 looking south-west towards the northern portion of the development footprint. One of these photos was selected for preparation of a photomontage (refer to Photograph 5.5). Photomontages enable potential visual changes from a viewpoint to be illustrated on a photograph, with the objective of simulating the visual extent of project infrastructure, once constructed. The photomontage conservatively assumes the height of the dominant project infrastructure, the PV solar panels, will be 2.4 m. As noted in Section 4.4, the PV solar panels will be constructed in a single axis tracking configuration, which will allow the PV solar panels to rotate from east to west during the day tracking the sun's movement. Therefore, the average height of the PV solar panels will be approximately 1.2 m. Consequently, it is assumed that the actual visible extent of project infrastructure from the residence at R2 will be less than the area shown in Photograph 5.5 for the majority of the daytime tracking period.
Magnitude of change	**Moderate** – the relatively low height of the project infrastructure and distance to the development footprint will limit the scale of change and degree of contrast for any views from R2. Although a significant level of vegetation was observed along the southern boundary of this property, this vegetation is unlikely to provide complete screening of the northern portion of the development footprint. Subsequently, the project infrastructure will add new features to the visual landscape at this location (refer to Photograph 5.4).

Table 5.3 Viewpoint 2 – dwelling north-east of the development footprint looking south-west towards the development footprint

Visual sensitivity	**Moderate** – due to the presence of a rural dwelling.
Evaluation of significance	**Moderate** – there would not be a significant impact from this viewpoint. Without mitigation, visual impacts from this viewpoint would continue throughout the life of the project.
Additional mitigation	A conceptual landscaping plan is shown in Figure 4.2, which presents the option for landscaping along portions of the northern and eastern boundaries of the northern portion of the development footprint. This landscaping will further reduce the potential visibility of project infrastructure from R2.

Photograph 5.3 Viewpoint 2 – dwelling north-east of the development footprint looking south-west toward the development footprint

Photograph 5.4 **Viewpoint 2 – dwelling north-east of the development footprint**

Potential visible extent of project infrastructure from R2

Orange Grove Sun Farm
Visual impact assessment
Photograph 5.5

EMM

5.3.4 Viewpoint 3 – Orange Grove Road looking north-west towards the development footprint

Table 5.4 Viewpoint 3 – Orange Grove Road looking north-west towards the development footprint

Viewpoint details	This viewpoint, shown in Photograph 5.6, is on Orange Grove Road looking north-west towards the northern portion of the development footprint. Photograph 5.6 was taken from Orange Grove Road approximately 30 m from the northern portion of the site's southern boundary and 1.2 km from the eastern boundary of the development footprint. The view direction in the photograph is to the north-west. As shown in Figure 5.1, there are a number of receptors (ie dwellings) south-east of this viewpoint on the southern side of the Namoi River. As part of the site inspection, it was observed that scattered remnant vegetation becomes increasingly dense towards the Namoi River south-east of this viewpoint. Subsequently, views of project infrastructure from these receptors would not be possible due to the screening effect of this vegetation. Further, as illustrated on Figure 5.1, these receptors are project-related.
View type and context	Views from this location represent a typical rural setting with a predominantly flat expanse of cleared, agricultural land. Scattered remnant vegetation increases in density in the background.
Visibility baseline assessment	The results of the viewshed analysis indicate that the project will result in the gain of viewshed visible from this viewpoint with features of the landscape likely to become more visible due to project infrastructure (Figure 5.3). However, as noted in Section 5.3.1, the viewshed analysis performed as part of this VIA did not take in to account the effects of existing remnant vegetation in screening views of project infrastructure from this location.
Magnitude of change	**Moderate** – While the project infrastructure may add new features to the visual landscape, views will be predominantly from motorists travelling west along Orange Grove Road. Assuming that motorists are travelling at the prescribed speed limit of 100 km/h along Orange Grove Road, it is estimated that travelling motorists would be exposed to views of the project's infrastructure for no more than 90 seconds over a distance of 2.5 km for motorists travelling west. Project infrastructure will not be the primary view from this viewpoint, as it is assumed the focus of motorists will be in line with their direction of travel along Orange Grove Road. Further, due to existing mature vegetation in the landscape (refer to Photograph 5.6), distance to the development footprint and the relatively low height of the dominant project infrastructure, namely the PV solar panels, the project's infrastructure will likely be partially shielded from view at this viewpoint.
Visual sensitivity	**Low** – due to its agricultural landscape character, absence of sensitive land use designations (RU1 Primary Production) and status as a local road.
Evaluation of significance	**Slight/moderate** – there would not be a significant impact from this viewpoint. Visual impacts from this viewpoint will continue throughout the life of the project.
Additional mitigation	No additional mitigation measures are warranted based on the evaluation of significance.

Photograph 5.6 **Viewpoint 3 – Orange Grove Road looking north-west towards the northern portion of the development footprint**

5.3.5 Viewpoint 4 – western boundary of the northern portion of the development footprint from Orange Grove Road

Table 5.5 Viewpoint 4 – western boundary of the northern portion of the development footprint from Orange Grove Road

Viewpoint details	This viewpoint, shown in Photograph 5.7, is on Orange Grove Road looking north-east towards the northern portion of the development footprint. Photograph 5.7 was taken from Orange Grove Road approximately 12 m from the south-western corner of the northern portion of the development footprint. The view direction in the photograph is to the north-east.
View type and context	Views from this location represent a typical rural setting with a predominantly flat expanse of cleared, agricultural land. Scattered remnant vegetation increases in density in the background.
Visibility baseline assessment	The results of the viewshed analysis indicate that the project will result in the loss of viewshed visible from this viewpoint with features of the existing landscape no longer visible due to project infrastructure (Figure 5.3).
Magnitude of change	**Moderate** – While the project infrastructure will add new features to the visual landscape, views will be predominantly from motorists travelling east along Orange Grove Road. Assuming that motorists are travelling at the prescribed speed limit of 100 km/h along Orange Grove Road, it is estimated that travelling motorists would be exposed to views of the project's infrastructure for no more than 47 seconds over a distance of 1.3 km for motorists travelling east. Project infrastructure will not be the primary view from this viewpoint, as it is assumed the focus of motorists will be in line with their direction of travel along Orange Grove Road.
Visual sensitivity	**Low** – due to its agricultural landscape character, absence of sensitive land use designations (RU1 Primary Production) and status as a local road.
Evaluation of significance	**Slight/moderate** – there would not be a significant impact from this viewpoint. Visual impacts from this viewpoint will continue throughout the life of the project.
Additional mitigation	No additional mitigation measures are warranted based on the evaluation of significance.

Photograph 5.7 **Viewpoint 4 – western boundary of the northern portion of the development footprint from Orange Grove Road**

5.3.6 Viewpoint 5 – Orange Grove Road looking east towards the development footprint

Table 5.6 Viewpoint 5 – Orange Grove Road looking east towards the development footprint

Viewpoint details	This viewpoint, shown in Photograph 5.8, is on Orange Grove Road looking east towards the development footprint. Photograph 5.8 was taken from Orange Grove Road approximately 1.8 km from the development footprint's western boundary. The view direction in the photograph is to the east. This viewpoint is within proximity of a number of receptors (ie dwellings) off Orange Grove Road, west of the development footprint (R8, R9, R10 and R11 – refer to Figure 5.2). The distances between these dwellings and the development footprint are variable and range between 1.6 km (R9) and 2.1 km (R11). Views are also considered representative of those experienced by motorists travelling east along Orange Grove Road, west of the development footprint. This viewpoint is approximately 1.1 km east of the proposed development footprint for the Gunnedah Solar Farm (Figure 3.1).
View type and context	Views from this location represent a typical rural setting with a predominantly flat expanse of cleared, agricultural land. Scattered remnant vegetation increases in density in the background leading to rolling hills east of the Oxley Highway at Carroll. As seen in Photograph 5.8, an additional visual feature at this location is an existing power line, which traverses the landscape on the southern side of Orange Grove Road. TransGrid's 132 kV transmission line is also visible from this viewpoint.
Visibility baseline assessment	The results of the viewshed analysis indicate that the project will result in the gain of viewshed visible from this viewpoint with features of the landscape likely to become more visible due to project infrastructure (Figure 5.3). In addition, the project will also result in the loss of viewshed visible from this viewpoint with features of the existing landscape no longer visible due to project infrastructure (Figure 5.3). However, as noted in Section 5.3.1, the viewshed analysis performed as part of this VIA did not take in to account the effects of existing remnant vegetation in screening views of project infrastructure from this location.
Magnitude of change	**Low** – the relatively low height of the project infrastructure and distance to the development footprint will limit the scale of change and degree of contrast for any views from this location. A review of satellite imagery indicates that there is vegetation present around each of the receptors (R8, R9, R10 and R11) close to this viewpoint, which, along with structures associated with agricultural operations, would act to further screen views of project infrastructure within the development footprint. Project infrastructure will not be the primary view for motorists travelling east along Orange Grove Road from this viewpoint, as it is assumed the focus of motorists will be in line with their direction of travel.
Visual sensitivity	**Moderate** – due to the presence of rural dwellings.
Evaluation of significance	**Slight/moderate** – there would not be a significant impact from this viewpoint. Visual impacts from this viewpoint will continue throughout the life of the project.
Additional mitigation	No additional mitigation measures are warranted based on the evaluation of significance.

Photograph 5.8 **Viewpoint 5 - Orange Grove Road looking east towards the development footprint**

5.3.7 Viewpoint 6 – Orange Grove Road looking west towards the development footprint

Table 5.7 Viewpoint 6 – Orange Grove Road looking west towards the development footprint

Viewpoint details	This viewpoint, shown in Photograph 5.9, is on Orange Grove Road looking west towards the development footprint. Photograph 5.9 was taken from Orange Grove Road approximately 3.6 km from the eastern boundary of the northern portion of the development footprint. The view direction in the photograph is to the west.
View type and context	Views from this location represent a typical rural setting with a predominantly flat expanse of cleared, agricultural land. Scattered remnant vegetation increases in density in the background. As seen in Photograph 5.9, TransGrid's 132 kV transmission line is a prominent visual feature in the landscape at this location.
Visibility baseline assessment	The results of the viewshed analysis indicate that the project will result in only minor changes to the viewshed visible from this viewpoint (Figure 5.3). However, as noted in Section 5.3.1, the viewshed analysis performed as part of this VIA did not take in to account the effects of existing remnant vegetation in screening views of project infrastructure from this location.
Magnitude of change	**Negligible –** it is unlikely that viewers at this location will have views of the project infrastructure due to the distance from the development footprint, existing remnant vegetation within the landscape and the height of the dominant project infrastructure, namely the PV solar panels. Project infrastructure will not be the primary view from this viewpoint, as it is assumed the focus of motorists will be in line with their direction of travel along Orange Grove Road.
Visual sensitivity	**Low** – due to its agricultural landscape character, absence of sensitive land use designations (RU1 Primary Production) and status as a local road.
Evaluation of significance	**Negligible** – there would not be a significant impact from this viewpoint.
Additional mitigation	No additional mitigation measures are warranted based on the evaluation of significance.

Photograph 5.9 **Viewpoint 6 – Orange Grove Road looking west towards the development footprint**

5.4 Reflectivity and glare

Reference materials from the NSW Government's Department of Industry Division of Resources and Energy (2016), Solar Trade Association (2016) and the Federal Aviation Administration of the United States (2010) indicate that, in general, as little as 2% of the light received is reflected by PV solar panels. As noted by both the Federal Aviation Administration of the United States (FAA 2010) and Spaven Consulting (2011), this degree of reflectivity is less than the reflectivity produced by a wide variety of different surfaces, including surfaces within the immediate vicinity of the project's development footprint, such as bare soil and vegetation, and is similar to the reflectivity of smooth bodies of water. Further, the NSW Department of Planning (2010) acknowledged in a discussion paper on solar energy technology that potential for glare associated with non-concentrating PV solar systems is relatively limited and PV solar panels will not generally create noticeable glare when compared with an existing roof or building surface.

The potential impacts of reflectivity on receptors, primarily dwellings within close proximity of the development footprint and motorists travelling along Orange Grove Road, are glint and glare. Glint refers to shorter period and more intense levels of exposure, while glare refers to sustained or continuous periods of exposure to excessive brightness, but at a reduced level of intensity (Morelli 2014). The amount of glint and glare produced by a PV solar panel is variable and is dependent on the angle of the PV solar panels, with lower angles producing less glint and glare (Morelli 2014).

As described in Section 4.4, the project's PV solar panels will be constructed in a single axis tracking configuration. This configuration will allow the PV solar panels to rotate from east to west during the day tracking the sun's movement. Consequently, the degree of glint and glare experienced by receptors will be variable depending on the time of day and viewing location. For example, receptors west of the development footprint will only have potential to be impacted by glint and glare during the afternoon tracking period. However, as noted above, as little as 2% of the light received is reflected by PV solar panels, which is less than the reflectivity produced by a wide variety of surfaces in the existing environment surrounding and within the development footprint.

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 PV solar panels may occur, receptors will also likely experience direct sunlight, which will be a significantly brighter and more intense source of light than reflection from the PV solar panels within the development footprint. Nonetheless, glint and glare may result from the project and may have an impact on nearby receptors and motorists travelling along Orange Grove Road. Existing remnant vegetation in the landscape will reduce both the duration and location from which reflection from the PV solar panels may be visible. The intention of the proposed landscaping at R1 and R2 (refer to Section 4.8.1) is to remove the PV solar panels from view at these locations and will also mitigate any potential for glint or glare impacts.

In addition to the PV solar panels, other project infrastructure may also result in glint and glare depending on the angle of the sun and viewing location. For example, glint and glare may occur as a result of the mounting frameworks to support the panels, containerised inverters or perimeter security fencing. This infrastructure will be more sparsely dispersed within the development footprint and is unlikely to create noticeable glint or glare when compared with existing structures within the development footprint (eg agricultural sheds and wire fencing).

Spaven Consulting (2011) prepared a report to assess the potential impact of solar PV energy facilities located in off-airfield situations. Within this report, the potential for glare to pilots caused by sunlight reflected by PV solar panels was identified as the only significant aviation issue likely to be raised by PV solar energy facilities (Spaven Consulting 2011).

As noted within this report, PV solar energy facilities positioned away from airports and airfields are unlikely to present problems to pilots, with the only potential hazards likely to be encountered during the critical phases of flight, namely approach and landing (Spaven Consulting 2011). The report also concluded that there was no evidence at the time of publication of glare from any existing PV solar energy facilities affecting pilots and no cases of accidents in which glare caused by a PV solar energy facility was cited as a factor (Spaven Consulting 2011).

As noted in Section 3.7, the Gunnedah Airport is approximately 12 km west of the development footprint. The Gunnedah Airport's primary runway is positioned in an approximate north-west to south-east orientation (refer to Figure 3.1). Due to the distance between the Gunnedah Airport and the development footprint, it is unlikely that aircraft using this facility will pass directly over the site during the critical phases of flight as identified in the report produced by Spaven Consulting (2011). OVERLAND consulted with the Civil Aviation Safety Authority (CASA) during the preparation of this VIA to discuss the potential impact of the project on flights to and from the Gunnedah Airport. As part of this consultation, CASA acknowledged that, "*modern solar panels are designed to absorb light and not to reflect it and in addition the majority of designs on the market also have an anti-glare coating to further reduce visual impact."* As noted in Section 4.4, the PV solar panel designs considered for the project feature anti-reflective coating.

As part of this consultation, CASA also noted that there is the possibility that there are unregistered or uncertified aerodromes in the general vicinity of the site; however, their records indicate the closest is Lake Keepit Aircraft ALA 13 km from the development footprint (Figure 1.1). Therefore, CASA acknowledged that the development footprint is sufficient distance from both Gunnedah Airport and Lake Keepit ALA to not be of any concern to air navigation.

A scoping exercise was conducted by Solar Trade Association (2016) to help inform debates around development proposals for non-domestic solar PV developments in Scotland. The exercise identified a variety of examples of airports successfully operating with large installations of PV solar panels on airport-related infrastructure, adjacent to airport runways and/or under direct flight paths (Solar Trade Association 2016). REC PV solar panels are currently in use at the Giebelstadt Power Plant in Germany, which features 120,000 PV solar panels with a total capacity of 28 MW. This project is located adjacent to an airport currently used for general aviation purposes. Within the United States, four separate arrays of PV solar panels envelop the Denver International Airport, with a combined capacity of approximately 10 MW.

Within Australia, Adelaide Airport's Terminal One roof supports 760 PV solar panels with a capacity of 114 kW and Darwin Airport features a 4 MW solar farm, which includes 15,000 PV solar panels over 6 ha. In addition, the Ballarat Solar Park, which has an installed capacity of 300 kW, is positioned adjacent to the boundary of the Ballarat Airport.

The potential for low angled reflected sunlight to cause a distraction to drivers travelling along Orange Grove Road was considered as part of the traffic impact assessment for the project (Appendix I of the EIS). Due to the anti-reflective properties of the PV solar panels, they are not expected to cause a distraction to motorists travelling along Orange Grove Road.

During consultation with the landowners at R2 (Figure 5.2) and the Namoi Pistol Club, concerns were raised about the potential impacts of glare from the PV solar panels. Where screening in the form of existing remnant vegetation or landscaping removes the PV solar panels from view, potential impacts from glint or glare will be limited.

Given the requirements for perimeter security fencing and internal access roads within the development footprint, it is anticipated that the closest PV solar panels will be approximately 800 m south-west of the residence at R2.

In addition to the distance to the closest PV solar panel, the proposed landscaping to mitigate potential visual amenity impacts at R2 (Figure 4.2) will also limit views of the PV solar panels from this receptor and glint and glare impacts at this residence will not be significant.

The firing range at the Namoi Pistol Club is aligned in a north-south direction and is approximately 1.6 km north-east of the development footprint at its closest point. Given the alignment of the firing range, distance to the closest PV solar panels and presence of remnant vegetation within the landscape between the development footprint and the firing range, glint or glare are unlikely to present a significant impact to recreational users of the Namoi Pistol Club.

Based on the findings of previous assessments prepared for PV solar energy facilities, glint and glare from the project's PV solar panels and other project infrastructure are not expected to significantly impact the following:

- receptors within the vicinity of the development footprint;
- people engaged in agricultural activities in the surrounding landscape;
- recreational users of the Namoi Pistol Club;
- motorists travelling along the minor road corridor of Orange Grove Road;
- motorists travelling along a number of minor unsealed rural property access roads and farm tracks; and
- aircraft arriving at or departing from the Gunnedah Airport and Lake Keepit ALA.

Where screening in the form of existing remnant vegetation or landscaping removes the PV solar panels from view, potential impacts from glint or glare will be limited.

5.5 Community perceptions of large-scale solar developments

Both Ipsos (2015) and NSW Office of Environment and Heritage (OEH) (2015) have conducted separate investigations in to the acceptability of large scale solar facilities in Australia and NSW, respectively. Ipsos (2015) noted that, in contrast to wind farms, large scale PV solar facilities do not trigger strong reactions from neighbouring members of the community. In a survey of approximately 1,200 Australians, a slightly higher proportion of participants agreed that large scale solar facilities have a negative visual impact on the local landscape when compared with participants who disagreed (Ipsos 2015). However, a higher proportion neither agreed nor disagreed, which indicates a lack of knowledge about the potential visual impact of such facilities.

As part of an investigation in to community attitudes to renewable energy, OEH surveyed 2,000 adults from across NSW, with the majority of survey participants supporting the use of solar farms (OEH 2015). Of the small proportion of participants who opposed solar farms being located near their place of residence, visual impacts were one of the key concerns raised. This finding provides further evidence of the need for effective community consultation to ensure that surrounding landholders are adequately informed of the impact of the project on the surrounding landscape.

Community consultation as part of the project has focused on informing surrounding landholders of the development footprint and the likely visual impact of the project infrastructure on the local landscape. This has included the provision of images of PV solar panels, inverters and other associated infrastructure.

As noted during consultation with the property owners at R1, R2 and R8, project infrastructure will be restricted to the 253 ha area within the development footprint.

The results of this VIA indicate that the project will not have a significant visual impact on the majority of the surrounding receptors. Landscaping is proposed to reduce the visibility of project infrastructure from R1 and R2 (refer to Section 4.8.1).

5.6 Cumulative impacts

The construction of the project and the Gunnedah Solar Farm will expand the overall area within the Gunnedah Shire LGA that is occupied by solar infrastructure. Collectively, project infrastructure for the two developments will cover an area of over 450 ha, which represents approximately 0.09% of the total land area within the Gunnedah Shire LGA (Pitt&Sherry 2017). Once constructed, the PV solar panel arrays will be the prominent visual feature of both developments throughout their respective operational stages (refer to Photograph 3.1). A cumulative visual impact may result from the project being constructed in conjunction with the Gunnedah Solar Farm; however, due to the height of the dominant project infrastructure, both projects would be visible only within a local setting.

5.6.1 Cumulative impacts during construction

During construction, the landscape within the development footprint for both projects will undergo a number of physical changes, namely through the installation of project infrastructure, which will add new features to the visual landscape. Views of the two sites during construction will be possible for motorists travelling along Orange Grove Road; however, based on separation distances, it is anticipated that these views will be of only one site at any given time. Further, it is assumed the focus of these motorists will be in line with their direction of travel along this road corridor.

Views of the development footprint for both projects during construction may be possible from a number of receptors (ie dwellings) (namely R8, R9, R10 and R11 – Figure 5.1). R8, R9, R10 and R11 are approximately 1.4 km, 1.3 km, 1.1 km and 850 m from the proposed eastern boundary of the Gunnedah Solar Farm. The closest of these receptors to the project's western boundary is R9, which is a distance of approximately 1.6 km west. A review of satellite imagery indicates that there is vegetation present around each of these receptors (R8, R9, R10 and R11), which would act to further screen views of both sites during construction.

Due to their temporary nature (ie approximately nine months), the site establishment works and construction activities for the project are considered unlikely to have any significant visual impacts on nearby receptors. Subsequently, landscaping is not proposed to mitigate visual impacts during the construction stage of the project.

5.6.2 Cumulative impacts during operation

Project infrastructure from both projects will be visible to motorists travelling along Orange Grove Road; however, based on separation distances and the relatively low height of the dominant project infrastructure, it is anticipated that these views will be of only one site at any given time. As noted in Section 4.4, the panel designs considered for the project feature anti-reflective coating. Subsequently, the project's PV solar panels are not expected to cause a distraction to motorists travelling along Orange Grove Road.

A number of receptors (ie dwellings) may experience combined views of the project infrastructure from both projects (namely R9, R10 and R11 – Figure 5.1). Spatial separation between the project's development footprint and the proposed site for the Gunnedah Solar Farm, in conjunction with vegetation present around these receptors and project-specific mitigation measures are considered appropriate to mitigate potential cumulative impacts.

As noted in Section 4.8.1, landscaping is proposed to mitigate views from houses within a sensitive proximity to the development footprint for the project, namely R1 and R2. Individual landscaping plans will be prepared in consultation with the landholders.

5.7 Summary of visual assessment

A summary of the results of the analysis of visual impacts for each of the six viewpoints is provided in Table 5.8. Due to the anti-reflective properties of the PV solar panels, they are not expected to cause a distraction to motorists travelling along Orange Grove Road. Further, glint and glare are not expected to significantly impact the closest receptors.

Table 5.8 Summary of results of visual impacts at each viewpoint

Viewpoint	Distance to development footprint	Representative receptors	Project infrastructure visible based on viewshed analysis	Magnitude of change	Visual sensitivity	Evaluation of significance	Significant impact?	Additional mitigation proposed?	Potential for cumulative impacts?
Viewpoint 1	0 m*	Dwelling (R1)	Yes	High	Moderate	Substantial	Yes	Yes	No
Viewpoint 2	670 m**	Dwelling (R2)	Yes	Moderate	Moderate	Moderate	No	Yes	No
Viewpoint 3	1.2 km	Motorists	Yes	Moderate	Low	Slight/Moderate	No	No	No
Viewpoint 4	12 m	Motorists	Yes	Moderate	Low	Slight/Moderate	No	No	No
Viewpoint 5	1.8 km	Dwellings (R8, R9,R10 and R11) Motorists	Yes	Low	Moderate	Slight/Moderate	No	No	Yes
Viewpoint 6	3.5 km	Motorists	Yes	Negligible	Low	Negligible	No	No	No

**As noted in Table 5.2, the closest project infrastructure to R1 will be approximately 150 m from this residence.*

***As noted in Table 5.3, the closest project infrastructure to R2 will be approximately 760 m from this residence.*

6 Conclusion

A visual assessment has been conducted from a number of representative viewpoints surrounding the development footprint. The viewpoints were selected to represent views close to private residential properties and the closest road corridor (ie Orange Grove Road).

Six viewpoints have been assessed to demonstrate the visual impacts of the project. Due to existing remnant vegetation in the landscape and the relatively low height of the dominant project infrastructure, namely the PV solar panels, the project's infrastructure will be relatively shielded from view at a number of the viewpoints assessed as part of this VIA.

The project design, development footprint and placement of infrastructure have progressively evolved to minimise or avoid visual impacts, where possible. Nonetheless, the development of the project will result in some changes to the landscape. Visual impacts will occur during the construction and operational stages of the project. The visual landscape will be altered from its current state for the duration of the operational stage of the project.

The visual assessment determined that, of the viewpoints assessed, infrastructure may be visible to varying degrees from five viewpoints. Based on the presence of vegetation, combined with the relatively low height of the project's infrastructure, the impact assessment predicts:

- a negligible visual impact for Viewpoint 6;
- a slight/moderate visual impact for viewpoints 3, 4 and 5;
- a moderate visual impact for Viewpoint 2 (representative of views from R2); and
- a potentially significant impact for Viewpoint 1 (representative of views from R1) for the unmitigated scenario.

As a result of its close proximity to the western boundary of the development footprint, without the implementation of appropriate mitigation measures, R1 will be exposed to views of project infrastructure. Although a significant level of vegetation was observed along the eastern boundary of this property, this vegetation is unlikely to provide a sufficient level of mitigation to reduce the visual impacts experienced from this viewpoint during the operation of the project. The proponent will provide landscape screening to mitigate the visual impacts from R1.

As illustrated in Photograph 5.5, the relatively low height of the project infrastructure and distance to the development footprint will limit the scale of change and degree of contrast for any views from R2, which is approximately 760 m north-east of the northern portion of development footprint. The proponent will provide landscape screening to further reduce the visibility of project infrastructure from R2.

The final location and extent of landscaping at R1 and R2 will be determined during detailed design and following subsequent discussions with the project landowners and the property owners of R1 and R2 as part of preparation of the EMP.

The construction of the project and the Gunnedah Solar Farm will expand the overall area within the Gunnedah Shire LGA that is occupied by solar infrastructure. Based on the relatively low height of the dominant project infrastructure, namely the PV solar panels, and separation distances between the development footprint for the project and the Gunnedah Solar Farm, it is anticipated that there is limited potential for significant combined views of the project and the Gunnedah Solar Farm.

This VIA concludes that the implementation of additional mitigation measures, namely landscaping at R1 and R2, will ensure that the project will not have any significant adverse visual impacts on the locality.

Abbreviations

AHD	Australian Height Datum
ALA	aircraft landing area
CASA	Civil Aviation Safety Authority
DA	development application
DPE	NSW Department of Planning and Environment
EIS	environmental impact statement
EMP	environmental management plan
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GSC	Gunnedah Shire Council
Gunnedah LEP	Gunnedah Local Environmental Plan 2012
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometres
kV	kilovolt
LEP	local environmental plan
LGA	local government area
mm	millimetre
MW	megawatt
OEH	NSW Office of Environment and Heritage
OVERLAND	OVERLAND Sun Farming Pty Ltd
PV	photovoltaic
RMS	NSW Roads and Maritime Services
SEARs	Secretary's Environmental Assessment Requirements
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SSD	State significant development

VA Bulletin	Wind Energy: Visual Assessment Bulletin AB 01 For State significant wind energy development
VIA	visual impact assessment

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