

# VISUAL IMPACT ASSESSMENT

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## PROPOSED DUNEDOO 55MW SOLAR FARM at All Weather Road, Dunedoo NSW 2844

Prepared for: NGH Environmental

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# 1.0 Introduction

## 1.1 Background

Moir Landscape Architecture have been commissioned by NGH Environmental to prepare a Visual Impact Assessment (VIA) for the proposed Dunedoo 55MW DC Solar Farm, at All Weather Road, Dunedoo NSW 2844, and sited within Lot 137 DP754309, Lot 140 DP754309, Lot 1 DP854326, Lot 80 DP754309, Lot 37 DP754309 and/or Lot 11 DP130889, Lot 7012 DP93290, Lots 181-186 and 196-201 DP754291 and Lot 1 DP1260716 (**Figure 1**).

As cadastral information has little influence in defining visual catchments this assessment aims to identify the landscape character, and dominant features of the relevant visual catchments that the Study Site lies within. The purpose of this report is to provide an assessment of the potential visual impact of the proposal within the defined visual catchments. The VIA will support the submission to DPIE for State Significant development.

Survey work was undertaken during March 2018 using key viewpoints and locations with potential views towards the site. The report details the results of the field work, documents the assessment of the landscape character and visual setting, and assesses potential visual impacts associated with the proposal.

### 1.1.2 Project Requirements

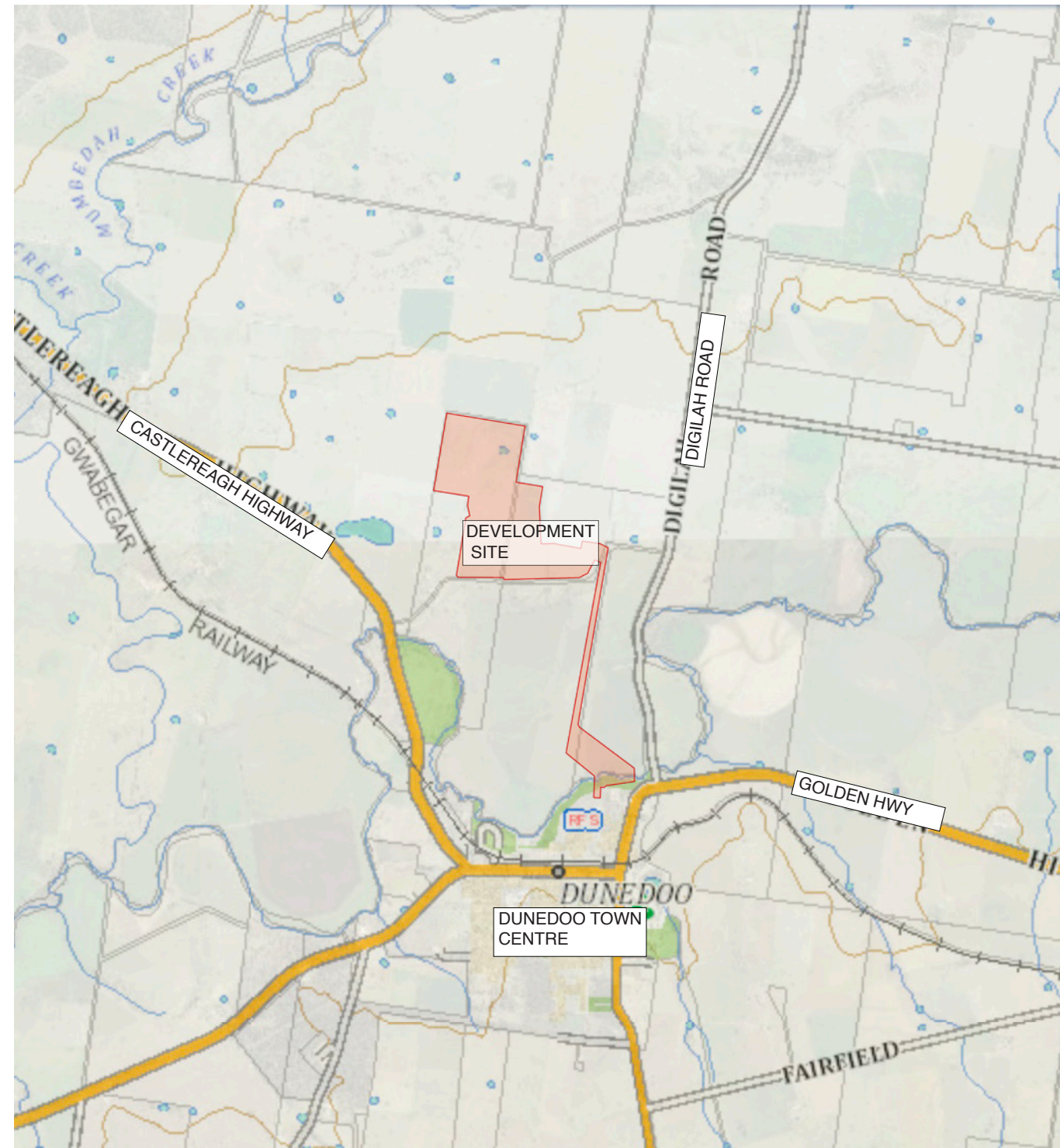
The report addresses the requirements related to the preparation of a VIA as per the Secretary's environmental assessment requirements for State significant development as per the EP&A Act S5.16. The Secretary's Environmental Assessment Requirements (SEARS) for application SSD 8847 Dunedoo Solar include:

**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.

**Light** - Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring (DPIE).

Other considerations for Landscape and Visual Impact Assessment:

- Include a full assessment of the visual impacts associated with the solar plant, including identification and documentation of all key viewing points and corridors particularly from identified sensitive lands. This should also include the associated transmission line.
- Include photomontages of the project taken from potentially affected residences (including approved but not yet developed dwellings or subdivisions with residential rights), settlements and significant public view points, and provide a clear description of proposed visual amenity mitigation and management measures for the solar plant;
- Provide an assessment of the feasibility, effectiveness and reliability of proposed mitigation measures and any residual impacts after these measures have been implemented; and
- Provide an assessment of the potential for reflectivity from the panels and associated infrastructure, and any safety impacts for motorists or aircraft.



**FIGURE 1:** Site Locality Plan

# 2.0 Study Method

## 2.1 Visual Impact Assessment (VIA)

VIA is used to identify and determine the value, significance and sensitivity of a landscape. The method applied to this study involved systematically evaluating the visual environment pertaining to the site and using value judgements based on community responses to scenery. The assessment was undertaken in stages as noted below. The first stage of the process involves:

Objective assessment of the relative aesthetic value of the landscape, defined as visual quality and expressed as high, medium or low. This assessment generally relates to variety, uniqueness, prominence and naturalness of the landform, vegetation and water forms within each character type.

- Determination of the landscape sensitivity and its ability to absorb different types of development on the basis of physical and environmental character.
- An assessment of viewer sensitivity to change. This includes how different groups of people view the landscape (for example, a resident as opposed to a tourist), and how many people are viewing and from how far.
- The undertaking of a viewpoint analysis to identify areas likely to be affected by development of the site and a photographic survey using a digital camera and a handheld GPS unit to record position and altitude.
- An assessment of visual impacts and the preparation of recommendations for impact mitigation. Suggestions are made for suitable development patterns that would maintain the areas visual quality.

The second stage of the assessment involves a quantitative approach. The quantification of the visual impacts is defined by methods including modelling of the site and the preparation of photomontages depicting the proposal.

The purpose of the above methodology is to reduce the amount of subjectivity entering into visual impact assessment and to provide sufficient data to allow for third party verification of results.

## 2.2 Guidelines and Statutory Framework

There are no specific guidelines for the development of solar farms in NSW. The following provides an overview of the guidelines, relevant frameworks and considerations of authorities utilised to form the methodology for this Visual Impact Assessment. In addition to these guidelines and frameworks, solar farm related literature and previous Visual Impact.

### 2.2.1 Warrumbungle Local Environmental Plan 2013

Under the LEP the project land is zoned as RU1 Primary Production. The instrument specified objectives of the zone and permissible activities:

#### 1 Objectives of zone

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.

- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.

#### 2 Permitted without consent

Environmental protection works; Extensive agriculture; Forestry; Home businesses; Home occupations; Intensive plant agriculture.

#### 3 Permitted with consent

Air transport facilities; Airstrips; Animal boarding or training establishments; Bed and breakfast accommodation; Boat launching ramps; Boat sheds; Camping grounds; Car parks; Cellar door premises; Cemeteries; Community facilities; Correctional centres; Crematoria; Depots; Dual occupancies; Dwelling houses; Eco-tourist facilities; Educational establishments; Environmental facilities; Extractive industries; Farm buildings; Farm stay accommodation; Flood mitigation works; Freight transport facilities; Helipads; Highway service centres; Home industries; Industrial training facilities; Information and education facilities; Intensive livestock agriculture; Jetties; Landscaping material supplies; Mortuaries; Neighbourhood shops; Open cut mining; Plant nurseries; Recreation areas; Recreation facilities (major); Recreation facilities (outdoor); Roads; Roadside stalls; Rural industries; Rural workers' dwellings; Signage; Veterinary hospitals; Water recreation structures; Water supply systems

#### 4 Prohibited :Any development not specified in item 2 or 3.

### 2.2.2 Secretary's Environmental Assessment Requirements

This VIA has been undertaken in response to Secretary's Environmental Assessment Requirements (SEARS) issued in November 2017 for the Project. In accordance with the SEARs the VIA is to include "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".

### 2.2.3 Dark Sky Planning Guideline - Protecting The Observing Conditions at Siding Spring

These guidelines are to be considered in the development of the lighting design for the proposal as the development is within the 200 km Dark Sky protection zone surrounding the Siding Springs Observatory.



# 2.0 Study Method

## 2.3 Definitions

Definitions for terms used throughout the VIA have been included in this section of the report.

### 2.3.1 Landscape Values

Landscape values are the set of principles that aid judgement of the place. These include attributes such as culture (heritage/indigenous), social, environmental as well as the aesthetics (judgements of nature, taste and beauty) as shown in Figure 2.



FIGURE 2: Landscape Values.

### 2.3.2 Visual Quality

Visual quality of an area is essentially an assessment of how viewers may respond to designated scenery. Scenes of high visual quality are those which are valued by a community for the enjoyment and improved amenity they can create. Conversely, scenes of low visual quality are of little value to the community with a preference that they be changed and improved, often through the introduction of landscape treatments.

As visual quality relates to aesthetics its assessment is largely subjective. There is evidence to suggest that certain landscapes are constantly preferred over others with preferences related to the presence or absence of certain elements. The rating of visual quality for this study has been based on scenic quality ratings and on the following generally accepted assumptions arising from scientific research (DOP, 1988):

- Visual quality increases as relative relief and topographic ruggedness increases.
- Visual quality increases as vegetation pattern variations increases.
- Visual quality increases due to the presence of natural and/or agricultural landscapes.
- Visual quality increases owing to the presence of water forms (without becoming too common) and related to water quality and associated activity.
- Visual quality increases with increases in land use compatibility.
- In addition to the above, cultural items may also endow a distinct character to an area and therefore contribute to its visual quality due to nostalgic associations and the desire to preserve items of heritage significance.

In addition to the before mentioned, cultural items may also endow a distinct character to an area and therefore contribute to its visual quality due to nostalgic associations and the desire to preserve items of heritage significance.

### 2.3.3 Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape is viewed by people from different areas. The assessment is based on the number of people affected, land use, and the distance of the viewer from the proposal. (EDAW, 2000).

For example, a significant change that is not frequently seen may result in a low visual sensitivity although its impact on a landscape may be high. Generally the following principles apply:

- Visual sensitivity decreases as the viewer distance increases.
- Visual sensitivity decreases as the viewing time decreases.
- Visual sensitivity can also be related to viewer activity (eg. a person viewing an affected site whilst engaged in recreational activities will be more strongly affected by change than someone passing a scene in a car travelling to a desired destination).

Sensitivity ratings are defined as high, moderate or low and are shown in the table below (Adapted from EDAW, 2000).

VISUAL SENSITIVITY					
LAND USE	DISTANCE ZONES				
	FOREGROUND		MIDDLE GROUND		BACKGROUND
	0-1	1-2km	2-4.5	4.5-7	> 7kms
Tourist / Recreation	High	High	High	Mod	Low
Residential: Rural or Urban	High	High	High	Mod	Low
Main Travel Corridor	Mod	Mod	Low	Low	Low
Minor / Local Roads	Mod	Mod	Low	Low	Low
Railway Line (Freight)	Low	Low	Low	Low	Low
Industrial Areas	Low	Low	Low	Low	Low

TABLE 1: Visual Sensitivity Table.



# 2.0 Study Method

## 2.3.4 Visual Effect

Visual effect is the interaction between a proposal and the existing visual environment. It is often expressed as the level of visual contrast of the proposal against its setting or background in which it is viewed.

**Low visual effect:** occurs when a proposal blends in with its existing viewed landscape due to a high level of integration of one or several of the following; form, shape, pattern, line, texture or colour. It can also result from the use of effective screening often using a combination of landform and landscaping.

**Moderate visual effect:** occurs where a proposal is visible and contrasts with its viewed landscape however, there has been some degree of integration (eg. good siting principles employed, retention of significant existing vegetation, provision of screen landscaping, appropriate colour selection and/or suitably scaled development).

**High visual effect:** results when a proposal has a high visual contrast to the surrounding landscape with little or no natural screening or integration created by vegetation or topography.

## 2.3.5 Visual Impact

Visual impact is the combined effect of visual sensitivity and visual effect. Various combinations of visual sensitivity and visual effect will result in high, moderate and low overall visual impacts as suggested in the below table (URBIS, 2009).

VISUAL IMPACT				
		VISUAL EFFECT ZONES		
		HIGH	MODERATE	LOW
VISUAL SENSITIVITY LEVELS	HIGH	High Impact	High Impact	Moderate Impact
	MODERATE	High Impact	Moderate Impact	Low Impact
	LOW	Moderate Impact	Low Impact	Low Impact

TABLE 2: Visual Impact Table.

## 2.3.6 Photomontages

A photomontage is a visualisation based on the superimposition of an image (i.e. the development - building, road, structure or landscape addition) onto a photograph for the purpose of creating a realistic representation of proposed or potential changes to a view. (Horner and Maclellennan et al, 2006). Photomontages have been utilised in this Visual Impact Assessment (refer to **Section 6.0**) to assist in the impact assessment of the proposal.

## 2.3.7 Photomontage Development Process

Photomontages are representations of the development that are superimposed onto a photograph of The Site. The process for generating these images involves computer generation of a wire frame perspective view of The Site and the topography from each viewpoint.

The photo simulations based on photography from typical sensitive viewpoints are included within the following analysis section. The images that the photo simulations were captured with a Canon EOS 5D Mark III Full Frame Digital SLR through a 50mm fixed focal lens which closely represent the central field of vision of the human eye.

## 2.6 Community Consultation

The degree to which viewers will be impacted is a result of an individuals personal response to the solar farm. This report is intended to be a tool to assist individuals in making an informed decision on the visual impact.

Community consultation was undertaken over two days one in December 2017 and again in March 2018 at Jubilee Memorial Hall, Dunedoo. The community response was helpful in identifying specific community concerns relating to visual impact.



# 3.0 Existing Landscape Character

## 3.1 Existing Landscape Character

The site is located in the Warrumbungle Local Government Area (LGA) within the rural area of Dunedoo, NSW. Regionally, Dunedoo is associated with the Orana Region of central west New South Wales. The proposed location for the solar farm is to the north of the town centre of Dunedoo. Traditionally the area is rich farmland used for cattle, sheep and wheat-growing. The Talbragar River traverses the southern boundary of the subject land.

### LAND USE

The main residential area and commercial centre of the small village of Dunedoo, is situated approximately 2km to the south. The subject land and surrounding lands are zoned RU1 - Primary Production. Dunedoo is located 80km north of Mudgee and 100km northeast of Dubbo.

Land use at the Development Site includes improved pasture (lucerne) in the south-eastern corner, sown oats in the north-western paddock, and weedy pasture elsewhere. The land has mainly been used for sheep grazing (80%) and cattle grazing (20%) by the current landowners. On occasion, oats and winter grasses have been cultivated. The main production value from the lot is meat, and wool is secondary. Similar agricultural land uses are undertaken on freehold properties surrounding the subject land, which are also included in the RU1 LEP zone. The principal activities on surrounding properties are cattle grazing, sheep grazing, horse stud, and oat growing.

### ROADS

The site is accessed by Golden Highway, Castlereagh Highway and Allweather Road. Allweather Road runs east - west along the southern boundary of the Development Site and connects to Digilah Road to the east and Castlereagh Highway to the west.

### TOPOGRAPHY

The topography of the area is fairly flat to a gently undulating land form consistent with central western NSW landscapes. Long range views from the site to the north are identified by a scenic backdrop of rolling hills and more densely vegetated ridgelines.

### VEGETATION

The site has undergone significant modification of its land cover and has been predominantly cleared of natural vegetation.

### CULTURAL HERITAGE

The area is on the border of Wiradjuri and Kamilaroi country and there is evidence to suggest that there was Aboriginal habitation in the area. There are few Aboriginal people still residing in the area and it is suggested that there were past massacres due to conflict over land and water as farms and mines expanded. Dunedoo is known for its bush poetry.

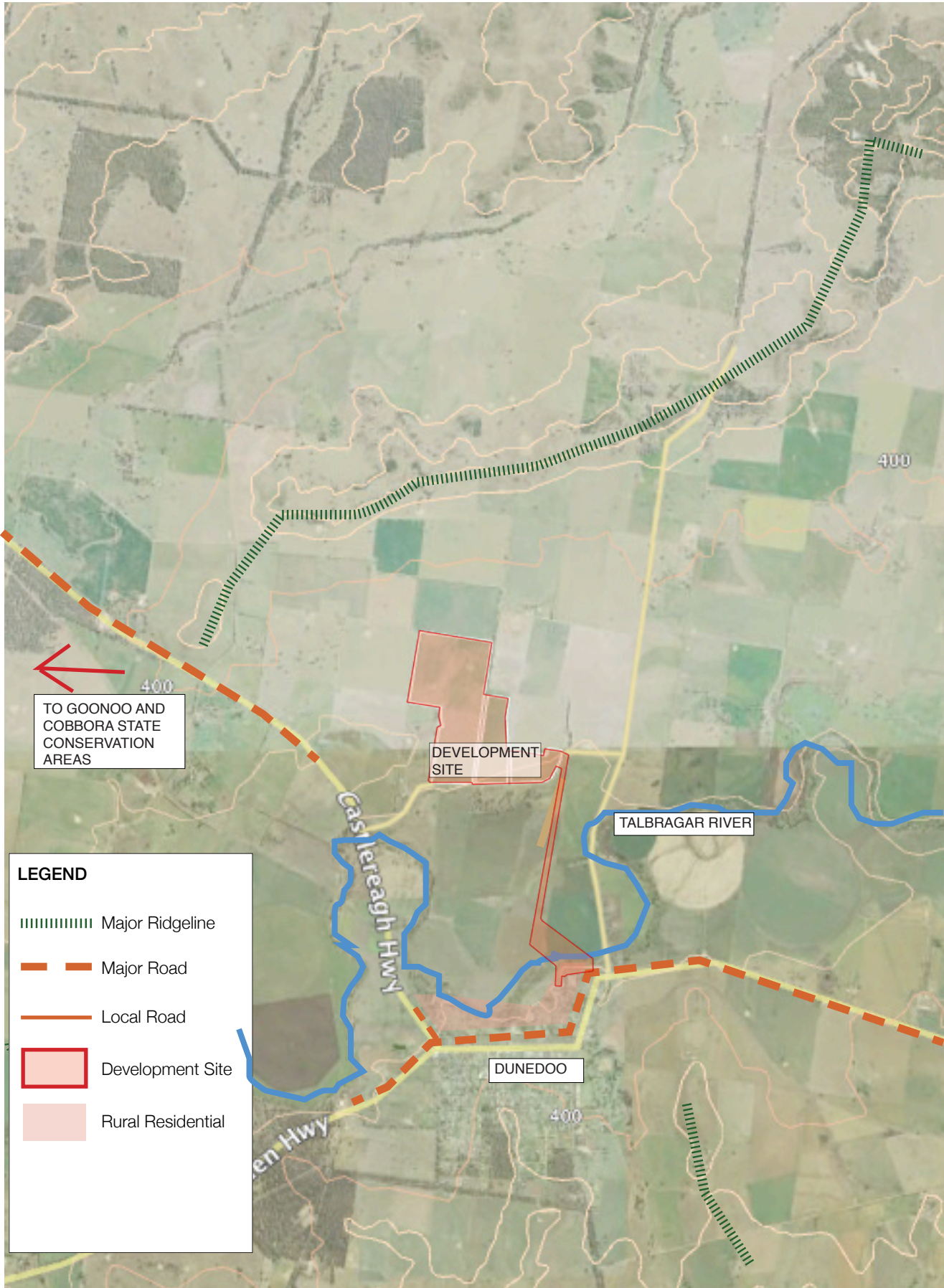


FIGURE 3: Existing Visual Character (Source: NSW Globe)



# 4.0 The Proposal

## 4.1 Site Description

The Proposal's Development Site, is the land that will be used for the construction and operation of the solar farm, and comprises the land required to construct the facility connection substation, the solar array, the proposed internal access tracks, and the corridor for the 66kV transmission line (TL) with an up to approximately 40m clearing easement.

## 4.2 Project overview

The proposal involves the construction of a ground-mounted photovoltaic (PV) solar array which will generate approximately 66 MW (DC) of renewable energy.

The solar array would comprise approximately 173,000 PV panels mounted in rows on a single axis tracking system.

A single axis system would be powered by 2,850 tracker motors. A single axis tracker would have a typical maximum height of approximately 3 metres, based on a two-metre vertical height panel and 2-metre-high support posts. Row lengths would depend on the detailed design but could be up to 100 metres. Spaces between rows (edges of panel) may vary between 3 metres and 9 metres. The indicative size of each PV panel is 2 x 1 metres.



# 5.0 Viewpoint Analysis

## 5.1 Viewpoint Analysis

This part of the visual assessment considers the likely impact that development would have on the existing landscape character and visual amenity by selecting prominent sites, otherwise referred to as viewpoints.

### 5.1.1 Viewpoint Selection Process

Viewpoints are selected to illustrate a combination of the following:

- Present landscape character types.
- Areas of high landscape or scenic value.
- Visual composition (eg. focused or panoramic views, simple or complex landscape pattern).
- Range of distances.
- Varying aspects. Various elevations.
- Various extent of development visibility (full and partial visibility).
- Sequential along specific routes.

Viewpoints have been carefully selected to be representative of the range of views within the study area. The selection of viewpoints is informed by topographical maps, field work observations and other relevant influences such as access, landscape character and the popularity of vantage points.

A total of **15 viewpoints** were taken as part of the field work process. The viewpoints were taken from publicly accessible roads surrounding the site. The viewpoints which have been included represent the areas from where the development would appear most prominent, either based on the degree of exposure or the number of people likely to be affected.

It is important to note that viewpoints for this study have been taken only from accessible public land (refer to **Figures 4 and 5** for locations).

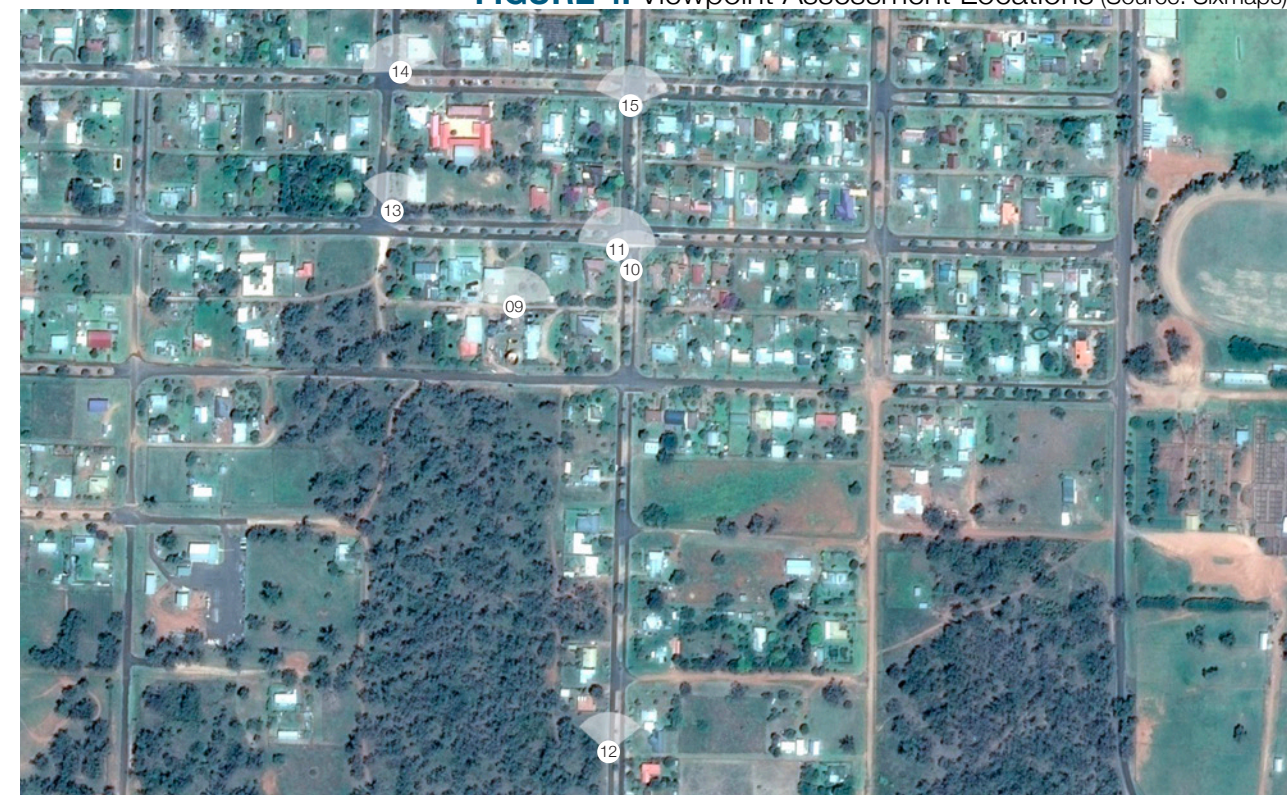
### 5.1.2 Process of Viewpoint Analysis

Once a viewpoint had been selected, panoramic photographs are taken at eye level from the viewpoints towards the site. Photographs were taken with a Canon EOS 5D Mark III digital SLR through a 50mm lens to best represent the perspective of the human eye.

The visual impact of the viewpoint was then assessed both on site and with the topographic and aerial information to ensure accuracy. Viewpoint photographs and analysis have been included in the following pages. The findings of the viewpoint analysis have been quantified and are summarised in **Table 4**.



**FIGURE 4:** Viewpoint Assessment Locations (Source: Sixmaps)



**FIGURE 5:** Dunedoo Town Viewpoint Assessment Locations (Source: Sixmaps)



# 5.0 Viewpoint Analysis



VIEWPOINT VP01 Digilah Road



VIEWPOINT VP01 Zoomed and cropped view from Digilah Road

VIEWPOINT VP01			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Digilah Road	This view is looking north west towards the site from Digilah Road. This is a minor road which connects to the Golden Highway and provides access to the eastern boundary of the proposed solar farm. The topography in this area is relatively flat and the landscape has been cleared of vegetation for farming, with the exception of scattered trees and roadside vegetation. A power line easement runs along the western edge of the roadside.  The Visual Sensitivity from this viewpoint has been rated as <b>low</b> due to the surrounding land use and low number of viewers..	From this viewpoint the proposed solar farm will <b>be</b> visible, appearing as a grey band in the distant ground. The solar farm will be partially screened due to a combination of the flat topography, existing vegetation both in the foreground and also along the southern boundary to the site and All Weather Road.  The visual effect from this viewpoint is assessed as <b>low</b> resulting in an overall visual impact of <b>low</b> .
COORDINATES	32°00'20.8"S 149°24'11.6"E		
ELEVATION	388m		
VIEWING DIRECTION	NW		
DISTANCE TO SITE	Approx. 1.25km		
LAND USE	Minor road		
VISUAL EFFECT	Low		
VISUAL IMPACT	Low		



# 5.0 Viewpoint Analysis



**VIEWPOINT VP02** Intersection of All Weather Road and Digilah Road



**VIEWPOINT VP02** Zoomed and cropped view from the intersection of All Weather Road and Digilah Roads

VIEWPOINT VP02			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Intersection of All Weather Road and Digilah Road	View from the intersection of All Weather Road and Digilah Road, looking north west. All Weather Road, is a minor local road which runs east west connecting Digilah Road and the Castlereagh Highway.  The solar farm is set back approximately 500m from Digilah Road and will be visible from this location.  The Visual Sensitivity from this viewpoint has been rated as <b>low</b> due to the land use and associated limited number of potential viewers.	From this viewpoint the solar farm will be visible, given the flat topography of the site and minimal vegetation screening.
COORDINATES	31°59'37.37"S 149°24'17.18"E		Due to proximity the visual effect from this location will be <b>moderate</b> .
ELEVATION	391m		The Visual Impact is determined to be <b>low</b> .
VIEWING DIRECTION	NW		<b>Refer to photomontage PM01.</b>
DISTANCE TO SITE	Approx. 550m		
LAND USE	Minor road		
VISUAL EFFECT	Moderate		
VISUAL IMPACT	Low		



# 5.0 Viewpoint Analysis (contd.)



VIEWPOINT VP03 View from Digilah Road



VIEWPOINT VP03 Zoomed and cropped view from Digilah Road

VIEWPOINT VP03			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Digilah Road	This photo is taken from Digilah Road looking south west, approximately 1.3km from the closest section of the array. Digilah Road is a minor road which provides access to the eastern boundary of the solar farm and adjoining properties. The landscape has been substantially cleared for use as rural land. Native trees remaining are scattered through the landscape and compose stands along drainage lines and fenced boundaries. The topography is generally flat, sloping slightly to the south towards the Talbrager River.  The Visual Sensitivity has been rated as <b>low</b> due to surrounding land use.	From this viewpoint the proposed solar farm will be visible.
COORDINATES	31°58'49.9"S 149°24'25.3"E		Due to the the distance to the proposal the visual effect is considered to be <b>low</b> .
ELEVATION	392m		The overall visual impact form this viewpoint is considered to be <b>low</b> .  <b>Refer photomontage PM02</b>
VIEWING DIRECTION	SW		
DISTANCE TO SITE	Approx. 1.38km		
LAND USE	Minor road		
VISUAL EFFECT	Low		
VISUAL IMPACT	Low		



# 5.0 Viewpoint Analysis



**VIEWPOINT VP04** View from intersection of Digilah Road and Lawson Park Road

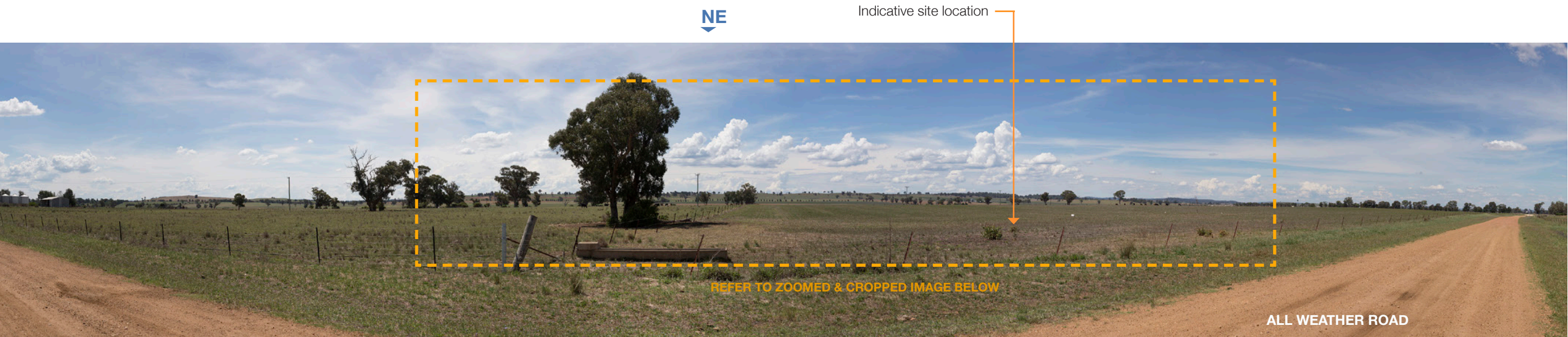


**VIEWPOINT VP04** Zoomed and cropped view from intersection of Digilah Road and Lawson Park Road

VIEWPOINT VP04			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Corner of Digilah Road and Lawson Park Road	View from the corner of Digilah Road and Lawson Park Road. Both roads are minor local roads which provide access to rural properties. The landscape has been substantially cleared. Native trees remaining are scattered through the landscape and compose stands along drainage lines and fenced boundaries. The proposed site is generally of flat topography.  The Visual Sensitivity of this viewpoint has been rated as <b>low</b> due to the surrounding land use.	From this viewpoint the solar farm would be visible, appearing as a grey band in the distant ground.
COORDINATES	31° 59'00.2"S 149° 24'24.5"E		Due to the distance from the proposal the Visual Effect is considered to be <b>low</b> .
ELEVATION	386m		
VIEWING DIRECTION	SW		The overall visual impact is determined to be <b>low</b> .  Refer to Photomontage PM03.
DISTANCE TO SITE	Approx. 1.22km		
LAND USE	Minor road		
VISUAL EFFECT	Low		
VISUAL IMPACT	Low		



# 5.0 Viewpoint Analysis (contd.)



VIEWPOINT VP05 View from All Weather Road

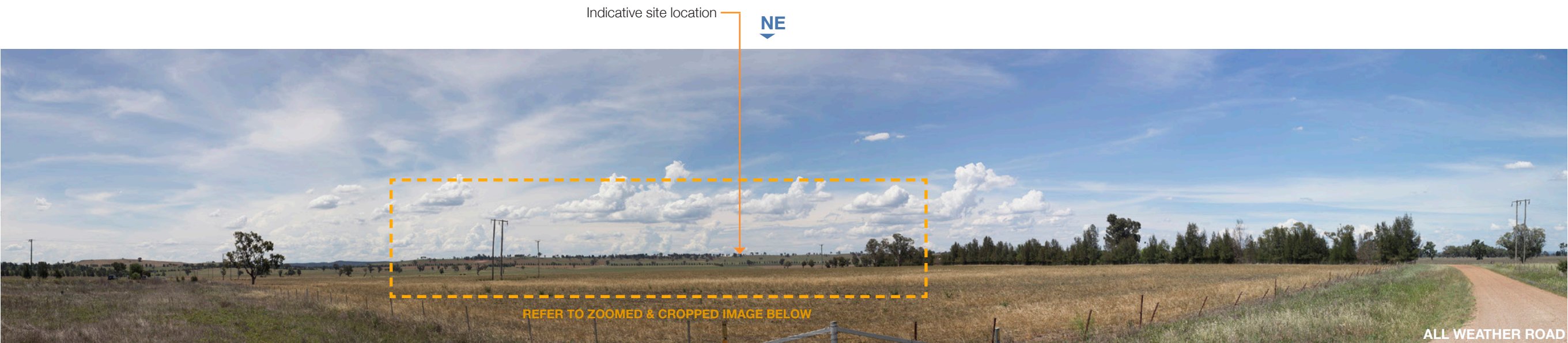


VIEWPOINT VP05 Zoomed and cropped view from All Weather Road

VIEWPOINT VP05		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	All Weather Road	View north east from All Weather Road, an unsealed access road, servicing rural properties.
COORDINATES	31° 59'44.6"S 149° 23'29.7"E	
ELEVATION	390m	Native trees remaining are scattered through the landscape and compose stands along drainage lines and fenced boundaries. The proposed site is generally of flat topography.
VIEWING DIRECTION	NE	
DISTANCE TO SITE	Approx. 50m	The Visual Sensitivity of this viewpoint has been rated as <b>moderate</b> due to the land use and close proximity to residential dwelling/s.
LAND USE	Minor road	
VISUAL EFFECT	Moderate	
VISUAL IMPACT	Moderate	
		POTENTIAL VISUAL IMPACT
		From this viewpoint the solar farm would be visible, given the flat topography of the site and virtually no natural vegetation screening.
		Due to the close proximity and contrasting nature of the panels within the view the visual effect of the Study Site from this viewpoint is rated <b>moderate</b> resulting in an overall visual impact of <b>moderate</b> .
		Refer to photomontage PM05.



# 5.0 Viewpoint Analysis



**VIEWPOINT VP06** View from All Weather Road

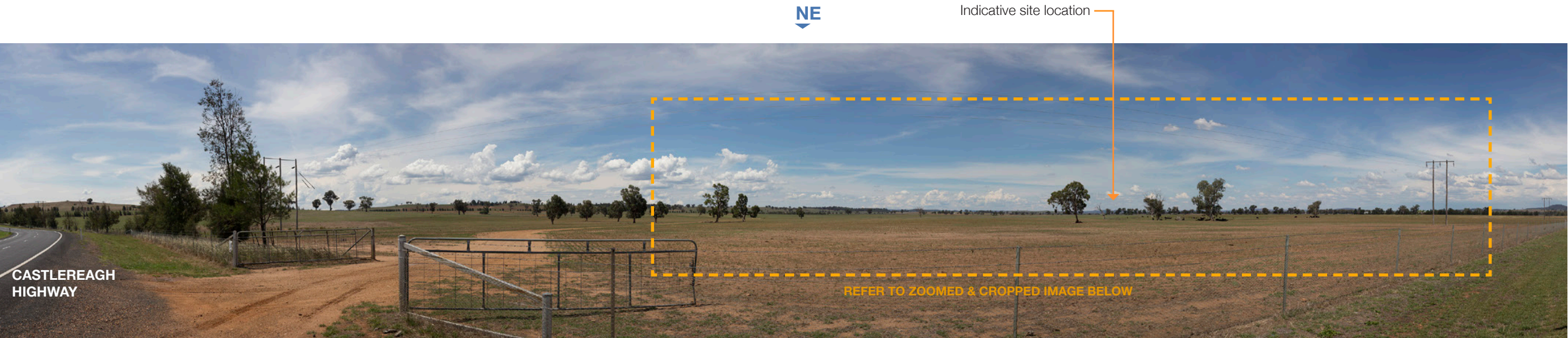


**VIEWPOINT VP06** Zoomed and cropped view from All Weather Road

VIEWPOINT VP06			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	All Weather Road	View from All Weather Road proximate to the intersection with the Castlereagh Highway. All Weather Road is a minor road which provides access to the southern boundary of the proposed solar farm. Views from this point are generally open across the flat landform of the rural landscape, however dense vegetation to the east, obscures views directly to the site. Multiple overhead power lines and associated easements are visible in the foreground.  The Visual Sensitivity of this viewpoint is <i>moderate</i> due to the land use and proximity to the Castlereagh Highway.	From this location the proposed solar farm would be primarily screened by the existing vegetation.
COORDINATES	31° 59'56."S 149° 22'54.0"E		Based on distance to the site, topography falling away from this viewpoint and existing screen vegetation the Visual Effect is rated as <i>low</i>
ELEVATION	386m		
VIEWING DIRECTION	NE		
DISTANCE TO SITE	Approx. 650m		The Visual Impact is rated as <i>low</i> .  <b>Refer to photomontage PM06.</b>
LAND USE	RU1 Primary Production		
VISUAL EFFECT	Low		
VISUAL IMPACT	Low		



# 5.0 Viewpoint Analysis (contd.)



VIEWPOINT VP07 View from the Castlereagh Highway



VIEWPOINT VP07 Zoomed and cropped view from the Castlereagh Highway

VIEWPOINT VP07		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	Castlereagh Highway	View from the Castlereagh Highway adjacent to a private access road. The Castlereagh Highway would be classed as a main road, providing access into the town centre of Dunedoo. Views from this location are generally open across the flat rural landscape. Scattered trees can be seen in the foreground, however the land has been generally cleared for farming purposes.  The Visual Sensitivity of this viewpoint has been rated as <i>moderate</i> due to the land use and the viewpoint position on a major road..
COORDINATES	31° 59'30.3"S 149°22'31.3"E	
ELEVATION	390m	
VIEWING DIRECTION	NE	
DISTANCE TO SITE	Approx. 980m	
LAND USE	RU1 Primary Production	Views would be partially obscured however, by a combination of the distance from the Study Site and existing vegetation.  The visual effect from this viewpoint is assessed as <i>low</i> resulting in an overall visual impact of <i>low</i> .  <b>Refer to photomontage PM07.</b>
VISUAL EFFECT	Low	
VISUAL IMPACT	Low	



# 5.0 Viewpoint Analysis



**VIEWPOINT VP08** View back to site from Digilah Road



**VIEWPOINT VP08** Zoomed and cropped view back to site from Digilah Road

VIEWPOINT VP08		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	Digilah Road	View from Digilah Road proximate to the intersection with the Golden Highway. Digilah Road is a minor road which provides access to the eastern boundary of the proposed solar farm. Views from this point are generally open across the flat landform of the rural landscape, however existing vegetation obscures views directly to the site. Multiple overhead power lines and associated easements are visible in the foreground.  The visual sensitivity from this viewpoint has been rated as <i>moderate</i> due to the land use and proximity to the Dunedoo township.
COORDINATES	32° 00'36.3"S 149° 24'13.8"E	
ELEVATION	392m	
VIEWING DIRECTION	NW	
DISTANCE TO SITE	Approx. 1.66Km	
LAND USE	RU1 Primary Production	
VISUAL EFFECT	Low	
VISUAL IMPACT	Low	
		POTENTIAL VISUAL IMPACT
		From this location the proposed solar farm would be visible to the north west, appearing as a very thin grey line in the distance. The solar farm would be slightly obscured by a combination of distance, flat topography and existing vegetation.  The visual effect from this viewpoint is assessed as <i>low</i> resulting in an overall visual impact of <i>low</i> .



# 5.0 Viewpoint Analysis



**VIEWPOINT VP09** View back to site from lane access between Yarrow Street and Bullinda Street



**VIEWPOINT VP09** Zoomed and cropped view back to site from lane access between Yarrow Street and Bullinda Street

VIEWPOINT VP09		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	Yarrow Street (laneway)	The view from the residential area of Dunedoo, on the laneway behind the houses fronting Yarrow Street, looking north towards the site. The view is dominated by residential housing in the foreground and the rural landscape in the distance.  The visual sensitivity from this viewpoint has been rated as <b>high</b> due to the residential land use.
COORDINATES	33° 11'42.52"S 151° 26'22.61"E	
ELEVATION	419m	
VIEWING DIRECTION	N	
DISTANCE TO SITE	Approx. 2.9km	
LAND USE	R1 General Residential	
VISUAL EFFECT	Low	
VISUAL IMPACT	Moderate	
		POTENTIAL VISUAL IMPACT
		From this location it is likely the proposed solar farm would be significantly screened by the residences, associated buildings and vegetation. The solar farm will be partially visible through the small gaps in these elements although it will be greatly diminished in the view due to distance.
		The visual effect from this viewpoint is assessed as <b>low</b> resulting in an overall visual impact of <b>moderate</b> .



# 5.0 Viewpoint Analysis



**VIEWPOINT VP10** View back to site from Tallawang Street



**VIEWPOINT VP10** Zoomed and cropped view back to site from Tallawang Street

VIEWPOINT VP10		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	Tallawang Street	View looking north along Tallawang Street, south of the intersection with Yarrow Street. Views from this location are generally concealed by residential housing and associated vegetation, roadside planting and overhead power lines.  The visual sensitivity from this viewpoint has been rated as <b>high</b> due to the land use .
COORDINATES	32° 01'17.4"S 149° 23'44.3"E	
ELEVATION	418m	
VIEWING DIRECTION	N	
DISTANCE TO SITE	Approx. 3km	
LAND USE	R1 General Residential	
VISUAL EFFECT	Low	
VISUAL IMPACT	Moderate	
		POTENTIAL VISUAL IMPACT
		From this location it is likely the proposed solar farm will be partially visible through the gaps in the buildings and vegetation, however it will be generally obscured by these elements. Given the distance from the site, it is likely the solar farm would appear as a thin grey line, which would not be sufficient to substantially alter the character of the view.  The Visual Effect is rated as <b>low</b> and the overall Visual Impact is rated as <b>moderate</b> .



# 5.0 Viewpoint Analysis



VIEWPOINT VP11 View back to site from the intersection of Tallawang and Yarrow Streets



VIEWPOINT VP011 Zoomed and cropped view back to site from the intersection of Tallawang and Yarrow Streets

VIEWPOINT VP11			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Yarrow Street	View looking in a north to north east direction from the intersection of Tallawang and Yarrow Streets. Views to the site are genrally concealed by residential housing and associated vegetation, roadside planting and overhead power lines.  The visual sensitivity from this viewpoint has been rated as <b>high</b> due to the land use.	From this location it is likely the proposed solar farm will be visible through the gaps in the buildings and vegetation, however it will be generally obscured by these elements. Given the distance from the site, it is likely the solar farm would appear as a thin grey line, which would not be sufficient to substantially alter the character of the view.  The Visual Effect is rated as <b>low</b> and following the overally Visual Impact is rated as <b>moderate</b> .
COORDINATES	32° 01'16.7"S 149° 23'43.9"E		
ELEVATION	417m		
VIEWING DIRECTION	N		
DISTANCE TO SITE	Approx. 2.9km		
LAND USE	R1 General Residential		
VISUAL EFFECT	Low		
VISUAL IMPACT	Moderate		



# 5.0 Viewpoint Analysis



**VIEWPOINT VP12** View back to site from Tallawang Street



**VIEWPOINT VP12** Zoomed and cropped view back to site from Tallawang Street

VIEWPOINT VP12			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Tallawang Street	View looking north towards the site from Tallawang Street. The view is dominated by residential housing, vegetation and overhead power lines.  The Visual Sensitivity from this viewpoint has been rated as <b>high</b> due to the number of residencesl.	From this location it is likely the proposed solar farm will be partially visible through small gaps in the buildings and vegetation. This, combined with the distance from the site, will mean the solar farm will not be sufficient to alter the character of the view.  The Visual Effect is rated as <b>low</b> and the overall Visual Impact is rated as <b>moderate</b> .
COORDINATES	32° 01'31.4"S 149° 23'43.7"E		
ELEVATION	410m		
VIEWING DIRECTION	N		
DISTANCE TO SITE	Approx. 3.8km		
LAND USE	R1 General Residential		
VISUAL EFFECT	Low		
VISUAL IMPACT	Moderate		



# 5.0 Viewpoint Analysis



VIEWPOINT VP13 View back to site from Merrygoen Street



VIEWPOINT VP13 Zoomed and cropped view back to site from Merrygoen Street

VIEWPOINT VP13		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	Merrygoen Street	View from the intersection of Merrygoen and Yarrow Streets. Views from this location are generally concealed by residential housing, vegetation, signage and overhead powerlines.  The Visual Sensitivity from this viewpoint has been rated as <i>high</i> due to the number of residences.
COORDINATES	32° 01'15.4"S 149° 23'35.4"E	
ELEVATION	408m	
VIEWING DIRECTION	N	
DISTANCE TO SITE	Approx. 2.84km	
LAND USE	R1 General Residential	
VISUAL EFFECT	Low	
VISUAL IMPACT	Moderate	
		POTENTIAL VISUAL IMPACT
		From this location it is likely the proposed solar farm will be partially visible through small gaps in the buildings and vegetation. This, combined with the distance from the site, will mean the solar farm will not be sufficient to alter the character of the view.  The Visual Effect is rated as <i>low</i> and overall the Visual Impact is rated as <i>moderate</i> .



# 5.0 Viewpoint Analysis



**VIEWPOINT VP14** View back to site from Tucklan Street



**VIEWPOINT VP14** Zoomed and cropped view back to site from Tucklan Street

VIEWPOINT VP14		
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION
LOCATION	Tucklan Street	View from the residential area of Dunedoo looking north from the intersection of Tucklan and Merrygoen Streets. The view is dominated by residential housing, vegetation and overhead power lines.  The visual sensitivity from this viewpoint has been rated as <b>high</b> due to the land use.
COORDINATES	32° 01'10.9"S 149° 23'35.0"E	
ELEVATION	408m	
VIEWING DIRECTION	N	
DISTANCE TO SITE	Approx. 2.7km	
LAND USE	R1 General Residential	
VISUAL EFFECT	Low	
VISUAL IMPACT	Moderate	
		POTENTIAL VISUAL IMPACT
		From this location it is likely there would be limited views of the proposed solar farm between the buildings and vegetation. This, combined with the distance from the site, will mean the solar farm will not be sufficient to alter the character of the view.  The Visual Effect is rated as <b>low</b> and the overall Visual Impact is rated as <b>moderate</b> .



# 5.0 Viewpoint Analysis



**VIEWPOINT VP15** View back to site from the intersection of Tallawang and Tucklan Streets



**VIEWPOINT VP15** Zoomed and cropped view back to site from the intersection of Tallawang and Tucklan Streets

VIEWPOINT VP15			
SUMMARY OF VIEWPOINT		VIEWPOINT DESCRIPTION	POTENTIAL VISUAL IMPACT
LOCATION	Tallawang Street	This view is looking north from the residential area of Dunedoo, on the corner of Tallawang Street and Tucklan Street. Views towards the site are concealed by the residential housing, vegetation and overhead power lines in the foreground.  The visual sensitivity from this viewpoint has been rated as <i>high</i> due to the land use.	From this location it is likely there would be limited views of the proposed solar farm between the buildings and vegetation. This, combined with the distance from the site, will mean the solar farm will not be sufficient to alter the character of the view.  The Visual Effect is rated as <i>low</i> and overall the Visual Impact is rated as <i>moderate</i> .
COORDINATES	32° 01'11.4"S 149° 23'44.6"E		
ELEVATION	408.4m		
VIEWING DIRECTION	N		
DISTANCE TO SITE	Approx. 2.75km		
LAND USE	R1 General Residential		
VISUAL EFFECT	Low		
VISUAL IMPACT	Moderate		



# 5.0 Viewpoint Analysis

## 5.2 Overview of Viewpoint Analysis

As discussed in the rationale for the viewpoint selection process, these viewpoints are representative of the worst case scenario. For each viewpoint, the potential visual impact was analysed through the use of a combination of topographic maps and on site analysis.

The visual sensitivity and visual effect of each viewpoint have been assessed which, when combined, result in an overall visual impact for the viewpoint (**Refer to Table 3**).

Of the **15** viewpoints assessed as part of this VIA, the proposal would be visible from a total of **15** viewpoints.

Of the **15** viewpoints from which the proposal would be visible,

- 7 received a Visual Impact Rating of LOW
- 8 received a Visual Impact Rating of MODERATE

VP05 is the closest viewpoint to the site and would experience the highest visual effect. It is however a very low use road and therefore with such a limited number of potential viewers on a daily basis the impact is negligible.

The remaining viewpoints which were determined to have a MODERATE impact are located in the town of Dunedoo on the elevated north facing slope south of Golden Highway. The High sensitivity rating of the viewpoints is related to the number of viewers associated with the population of the town. From these viewpoints it is likely that the solar farm will be visible, however at a distance of over 2.5km from most viewpoints the solar farm will not be a dominant element in the view. And although determined to be MODERATE in impact it is more likely that the impact of the proposal from these viewpoints will be negligible.

VIEWPOINT	VISUAL SENSITIVITY	VISUAL EFFECT	POTENTIAL VISUAL IMPACT	PHOTO MONTAGES
VP01	LOW	LOW	LOW	-
VP02	LOW	LOW	LOW	PM01
VP03	LOW	LOW	LOW	PM02
VP04	LOW	LOW	LOW	PM03
VP05	MODERATE	MODERATE	MODERATE	PM04
VP06	MODERATE	LOW	LOW	PM05
VP07	MODERATE	LOW	LOW	PM06
VP08	MODERATE	LOW	LOW	-
VP09	HIGH	LOW	MODERATE	-
VP10	HIGH	LOW	MODERATE	-
VP11	HIGH	LOW	MODERATE	-
VP12	HIGH	LOW	MODERATE	-
VP13	HIGH	LOW	MODERATE	-
VP14	HIGH	LOW	MODERATE	-
VP15	HIGH	LOW	MODERATE	-



# 6.0 Photomontages

## 6.1 Photomontage Development

Photomontages of the proposed solar farm were prepared to assist in the impact assessment of the proposal, conveying the final visual image from typical vantage points.

The initial photomontages are based on worst case scenario, without the inclusion of the proposed mitigation methods. Additional photomontages are provided showing measures to mitigate the impact of the solar farm and how they reduce the determined impact. Effort was made to ensure these photomontages reflect an accurate simulation of the proposed Solar Farm.

### 6.1.1 Photomontage Selection Process.

Photomontages of the proposed Solar Farm within the existing context were selected as key views and as a good indicator of general visibility of the Study site from the road. A total of 4 viewpoints were selected for the production of photomontages (refer to **Table 3**) which are generally those viewpoints determined to have the greatest potential for visual impact and best represent a range of distances as well as locations with differing



Computer generated display of solar farm



Wire frame perspective view over photograph



Resulting Photomontage

views. Locations of the photomontages are shown on **Figure 6**. The photomontages are based on a worst case scenario of a maximum height without the inclusion of the proposed mitigation methods. Zoomed and cropped photomontages have been included in the report to provide clarity.

### 6.1.2 Photomontage Development Process.

Photomontages are representations of the solar farm that are superimposed onto a photograph of the Site. The process for generating these images involves computer generation of a wire frame perspective view of the proposed solar farm. The photo simulations based on photography from typical sensitive viewpoints are included within the following analysis section. Photomontages have been prepared using current best practices.



**FIGURE 6:** Photomontage Assessment Locations (Source: Sixmaps)



# 6.0 Photomontages

PHOTOMONTAGE: PM01



EXISTING VIEWPOINT: VP02



SOLAR PANELS



SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)





# 6.0 Photomontages

Photomontage PM02

EXISTING VIEWPOINT: VP03



SOLAR PANELS



SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)





# 6.0 Photomontages

Photomontage PM03

EXISTING VIEWPOINT: VP04



SOLAR PANELS



SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)





# 6.0 Photomontages

Photomontage PM04

EXISTING VIEWPOINT: VP05



SOLAR PANELS





# 6.0 Photomontages

Photomontage PM05

EXISTING VIEWPOINT: VP06



SOLAR PANELS



SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)





# 6.0 Photomontages

Photomontage PM06

EXISTING VIEWPOINT: VP07



SOLAR PANELS



SOLAR PANELS WITH PROPOSED MITIGATION (10 year projection)





# 7.0 Assessment of Visual Impact

## 7.1 Assessment of Visual Impacts

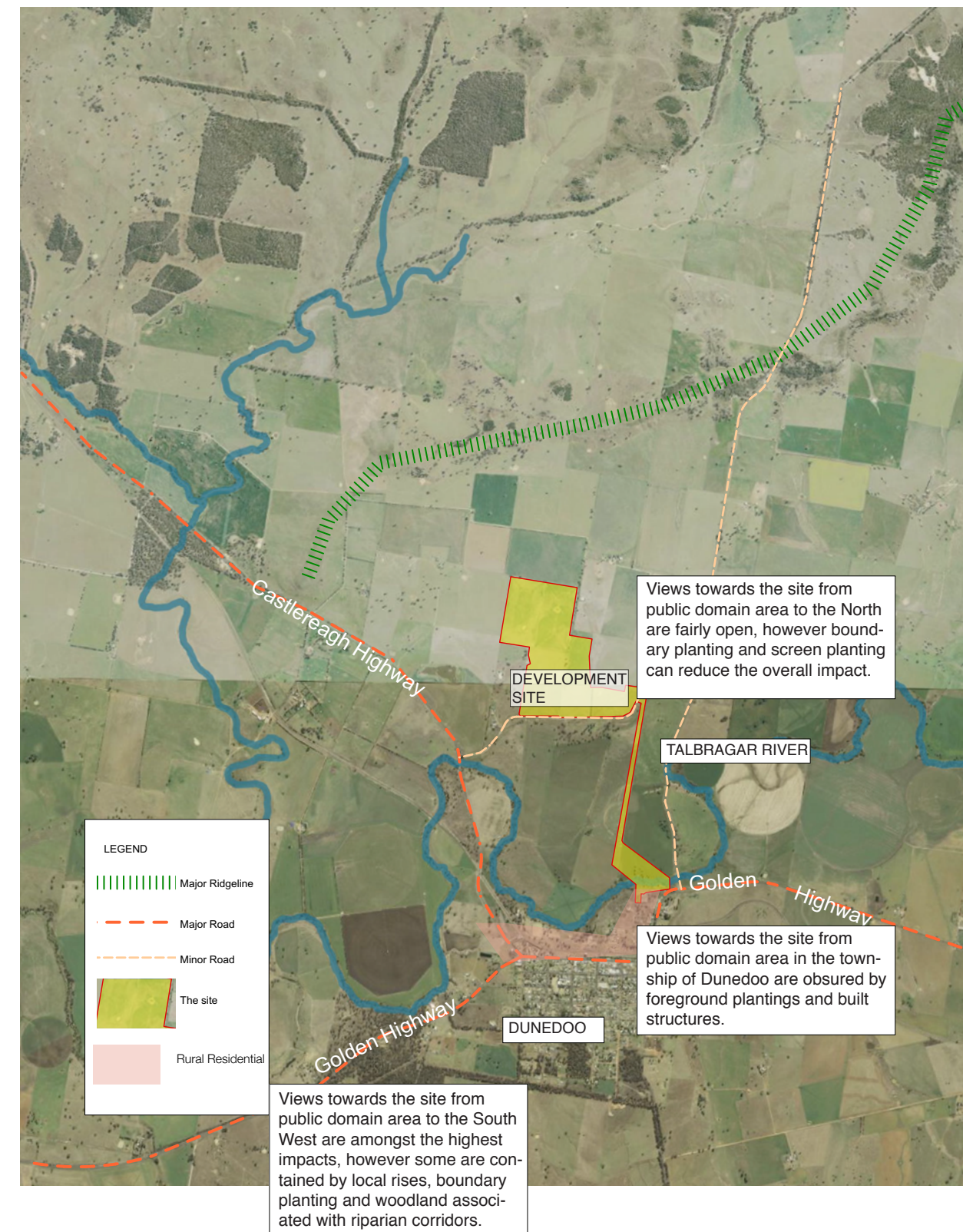
In addition to the photographic viewpoint assessment the following section provides an overview of the potential visibility from local areas surrounding the site. This is by no means an exhaustive description of the visibility from every residence or locality. It is intended to provide an overall assessment of the potential visual impact on areas potentially affected by the proposal.

The nature and scale of the project will introduce a new element into the existing landscape and visual environment. This part of the report will assess the source and magnitude of development effects on the existing landscape elements, character and quality in the context of the site and its environs.

Overall the proposed Dunedoo Solar Farm will result in impacts on the existing surrounding environment in terms of landscape and scenic values. The visual impacts associated with the proposal will vary depending on the viewing location.

The solar panel arrays are relatively low lying, reaching a height of approximately 3 metres above the existing ground level. The solar plant is constructed as an array of panels arranged in an north-south direction, tracking east to west on a single axis. The highest visual effect of the PV panels is likely to be seen from the east and west, where the most surface area is visible. Visibility of the solar farm from the north and south will be significantly lower. The visual impact is mostly likely to be at its highest during the construction phase. Although the construction of the solar plant will add a new element to the existing landscape. The site is relatively close to the outskirts of Dunedoo town and could be considered a transition zone between the density of the town and the broader rural landscape beyond.

The proposed development is situated between Castlereagh Highway along All Weather Road from the East, which is an unsealed road connecting to Digilah Road. There are clear and close views to the Site from these local roads. It is from Digilah and All Weather Roads that the development will effect the most significant change in character from the public domain. Visual impact in close proximity is generally brief and, due to the low nature of the development, easily mitigated with screen planting along the boundary line. Due to the undulating nature of the topography, distant views to the site are largely contained and where available it is likely the solar panels would appear as grey/black lines within open paddocks.



**FIGURE 7:** Visual Impact Assessment



# 7.0 Assessment of Visual Impact

## 7.2 Night Lighting

CCTV security cameras and security lighting are proposed.

There would be *no permanent* night lighting installed within the array, but lighting may be included in each PCS for conducting night maintenance when the solar plant is de-energised.

Any lighting installed should be in accordance with AS4228-1997 - *Control of Obtrusive Effects of Outdoor Lighting*

## 7.4 Reflectivity

Due to the materials used in the construction of PV panels being primarily glass and steel there is a perceived issue of glint and glare surrounding the reflectivity solar panels.

As a result of the perceived reflection levels, there is a concern of possible distractions to motorists, aircraft and the hazard of eye damage. Bodangora Airfield is 64km southwest of the proposal.

The Solar Panels proposed for the installation (type TBC) are designed to absorb the sun's energy and directly convert it to electricity. Modern PV modules absorb approximately 82-93% of the light received.

The Solar Panels are designed using anti-reflective solar glass effectively reducing reflectivity. Thin slivers of metal stripping on the face of the panels further reduce any potential glare issues that may occur.

The level of glare and reflectance from the PV solar panels are considerably lower than the level of glare and reflectance of common surfaces, particularly those surrounding the proposed Solar Plant. The PV panels would reflect approximately 7-18% of energy which is less than typical rural environments which have a reflectivity of approximately 15-30%. Figure 9 and 10 compares the percentage of reflected energy from common reflective surfaces to that of a PV Solar Panel.

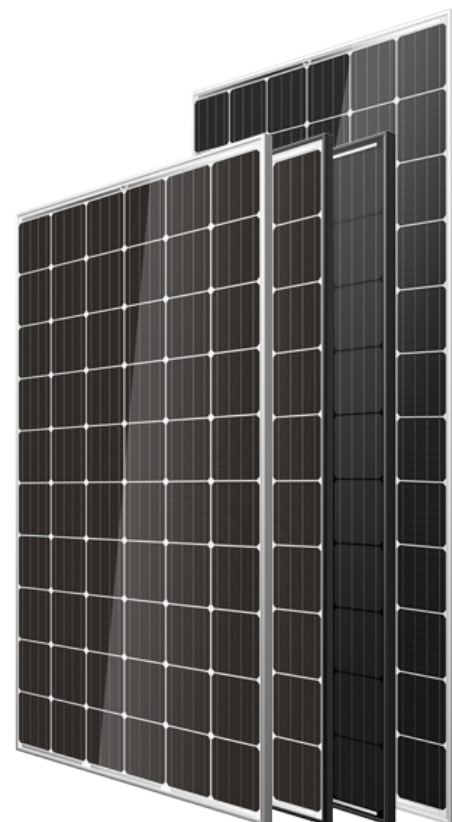


Figure 8: Example Solar Panel  
<http://trinasolar.com/au/resources/downloads>

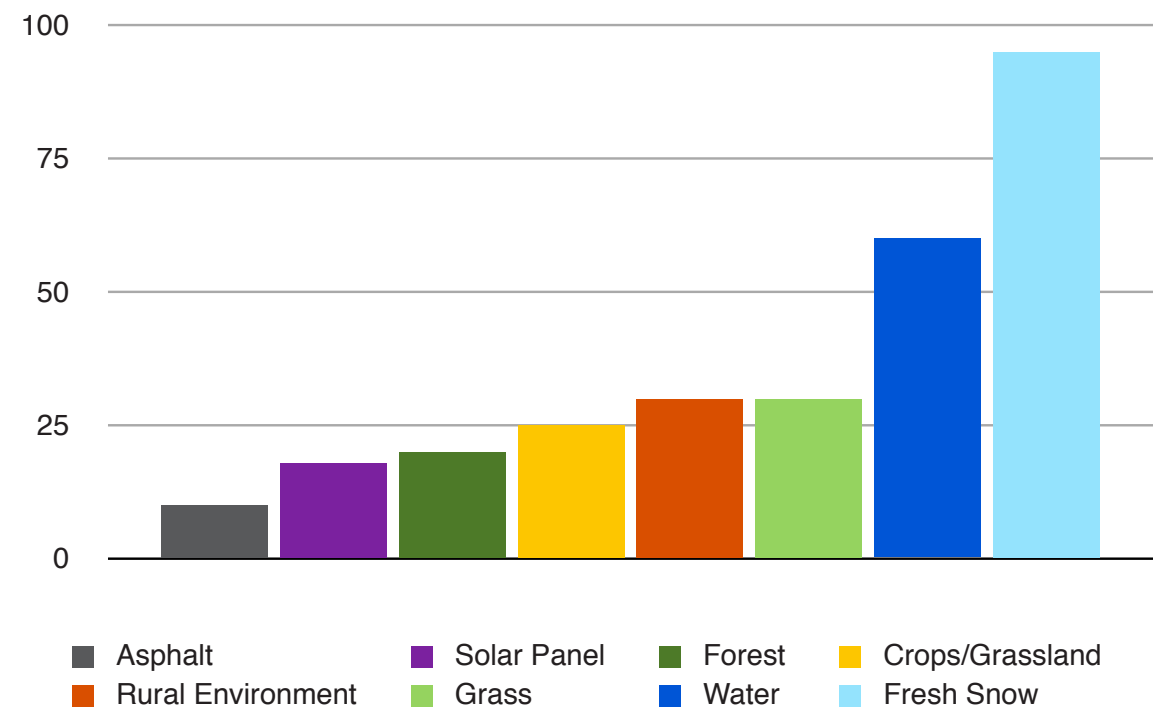


Figure 9: Comparative reflection analysis.

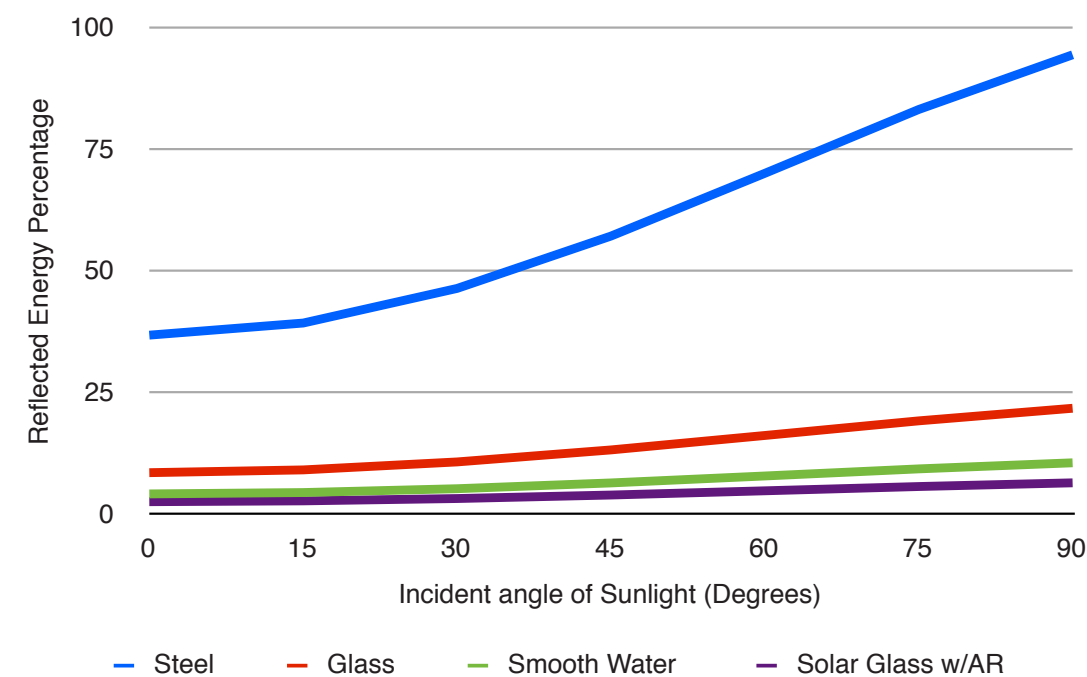


Figure 10: Analysis of typical material reflectivity.



# 8.0 Mitigation Recommendations

## 8.1 Mitigation Recommendations

It has been identified that the most significant Visual Impact when viewed from the public domain is from locations along Digilah Rd and All Weather Rd where the proposal is in close proximity to the boundary and where there is inconsistent existing vegetation of a sufficient scale to screen or fragment views.

As solar arrays are generally 3 metres or below in height (fixed or tracking) they can generally be screened by relatively narrow bands of vegetation if the vegetation consists of a mix of tree and mid level shrub species.

In the case of the Dunedoo Solar Farm it is our recommendation that a band of screen planting approximately 6 metres wide or equivalent to three (3) rows of vegetation in high visual impact areas and two (2) rows in low / moderate visual impact areas, is positioned between the property boundary and the security fencing in locations where there is no existing vegetation and where the arrays are immediately adjacent to viewpoints in the public domain.

To ensure that the screen planting integrates into the existing landscape character, the bands should be planted with fast growing small trees and bushes, and low lying vegetation to ensure a naturalistic effect whilst also providing habitat and movement corridors for native fauna.

It is suggested that this mix includes the following species, which match the Plant community Type present at the site (as identified by the specialist ecology study):

Species	Height
<i>Acacia implexa</i>	10m
<i>Cassinia aculeata</i>	1.0-2.6m
<i>Dodonea viscosa subsp. cuneata</i>	<5m
<i>Geijera parviflora</i>	9m
<i>Myoporum montanum</i>	<8m
<i>Acacia deanei subsp. deanei</i>	1.5-7.0m
<i>Senna form taxon 'artemisioides'</i>	<2m

To ensure that mitigation planting is successful all landscape works should be maintained regularly for a period of 24 months. Maintenance should generally include the removal of weeds and replacement of dead or non-performing plants.

Screen planting should be considered for locations surrounding buildings associated with the proposal where appropriate.

Materials and colours utilised in the construction of site sheds, battery storage and associated infrastructure should also be considered to ensure that Visual Impacts are minimised. In general materials should be non-reflective and should be painted in neutral colours that are sensitive to the surrounding landscape.





# 8.0 Mitigation Recommendations

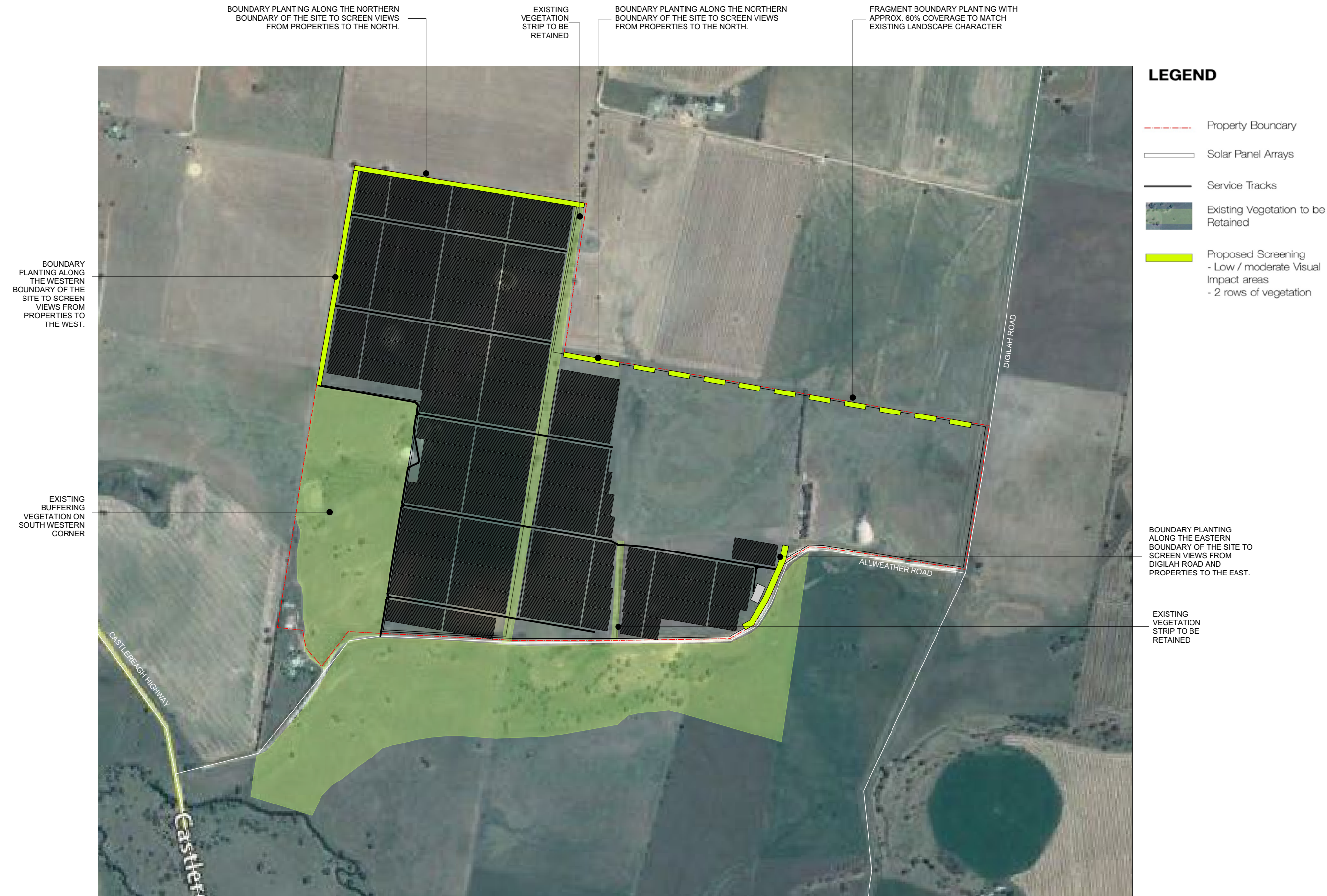
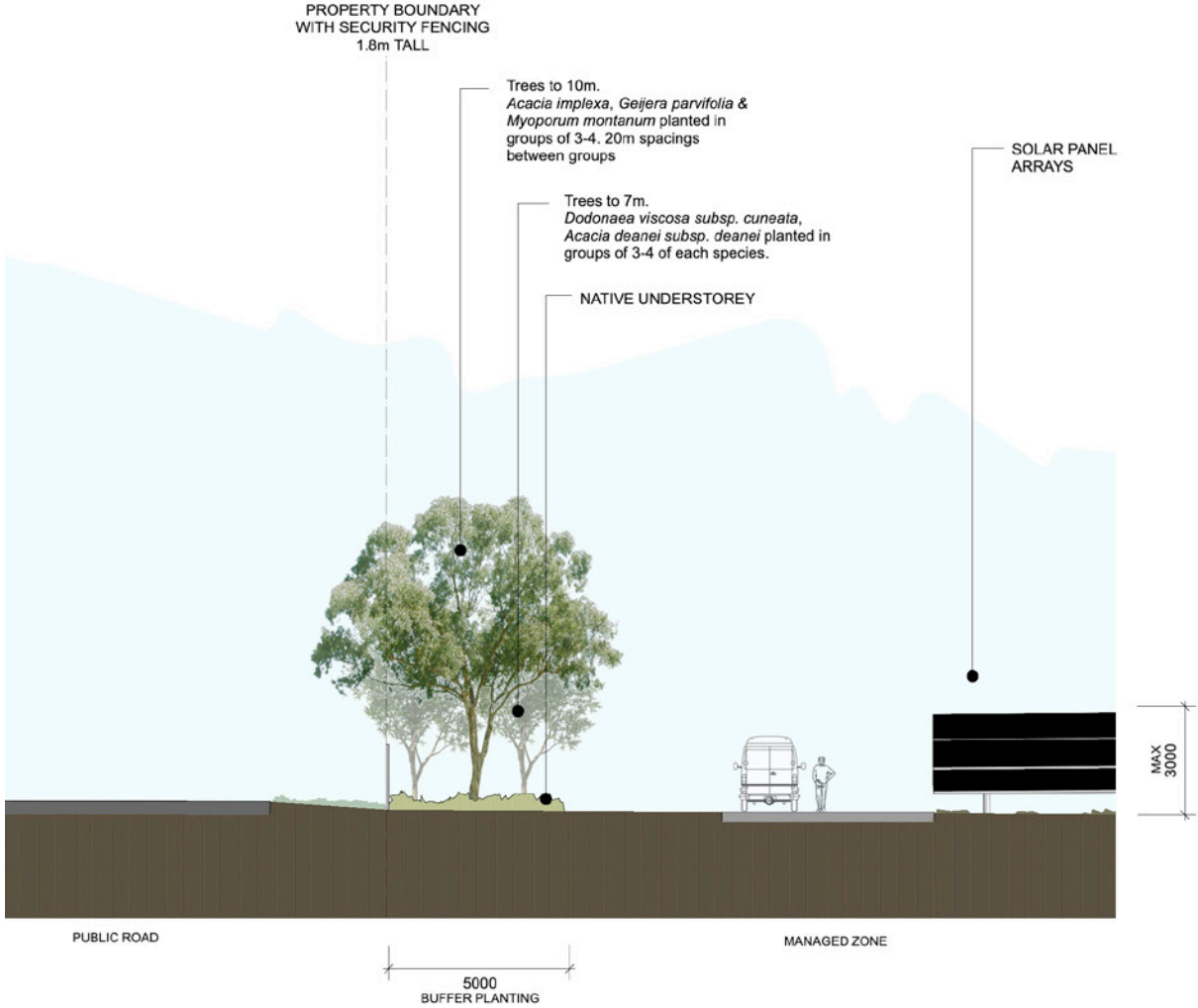


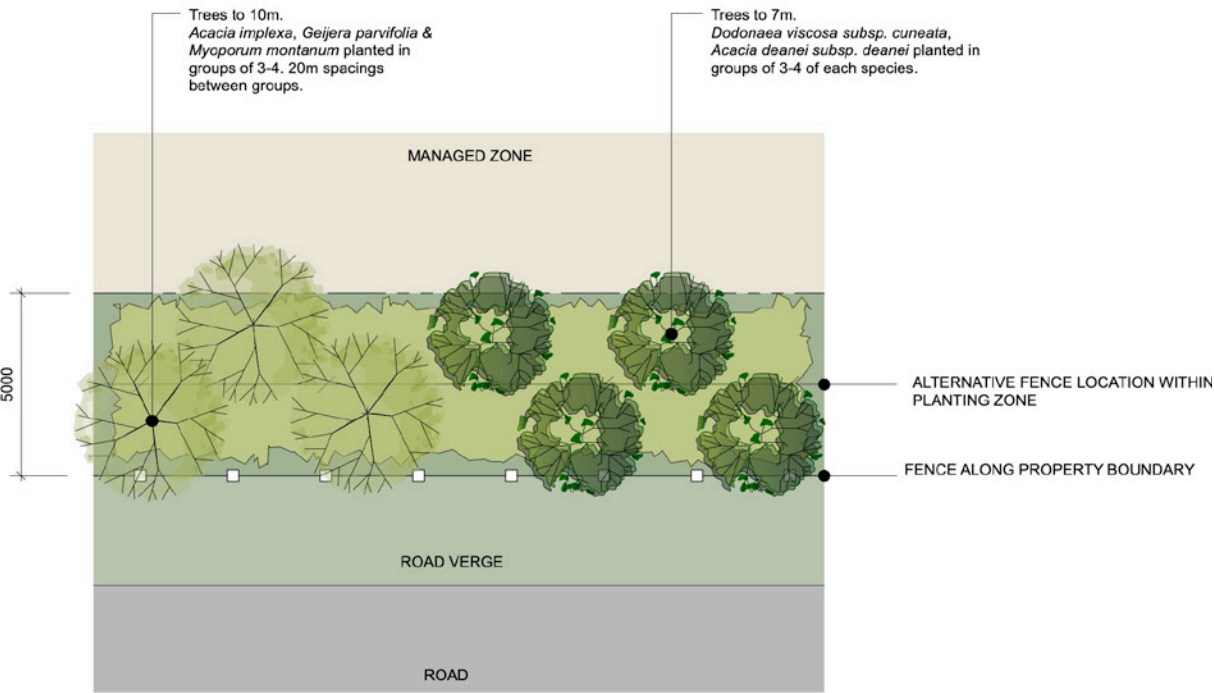
Figure 11: 1:5000 Visual Impact Mitigation Principles



# 8.0 Mitigation Recommendations



TYPICAL SECTION OF PROPOSED SCREENING ON SITE PERIMETER  
1:100



TYPICAL PLAN OF PROPOSED SCREENING ON SITE PERIMETER  
1:100



EXAMPLES OF SCREENING STRATEGY



Geijera parviflora      Acacia implexa      EUCALYPTUS MELLIODORA

EXAMPLES OF TREE TYPES



# 9.0 Summary of Visual Impact Assessment

## 9.1 Summary

With all visual impact assessments the objective is not to determine whether the proposal is visible or not visible, it is to determine how the proposal will impact on existing visual amenity, landscape character and scenic quality. If there is a potential for a negative impact on these factors it must then be investigated if and how this impact can be mitigated to the extent that the impact is reduced to an acceptable level.

Key elements of the existing landscape character are the distant vegetated ridge lines and immediate undulating pastoral landscape around Dunedoo as it transitions to central plains broad flat landscapes. The existing landscape character is predominantly agricultural with undulating open landscape. Existing infrastructure including power poles, rural infrastructure (ie. sheds and fencing) forms a part of the existing landscape character of the area.

The study site is also located close to the township of Dunedoo and is situated in what could be considered a transition area between the suburban residential and the surrounding agricultural land.

The assessment determined that the majority of the views to the proposal from public domain were contained or fragmented by vegetation and topography and were generally from viewpoints that would view the study site as a grey line in the distance. The most predominant visual impact will be from Allweather and Digilah Roads, however with the proposed vegetation screening the receiver will only perceive glimpses of the solar farm as they travel on these roads.

When implemented, planting of fast growing shrubs and small trees of species from the dominant plant community (listed in 8.1 Mitigation Recommendations) in the proposal site to the boundaries of the site as shown in Figure 11 will provide suitable screening to the site.

It is our opinion that if implemented with appropriate environmental management and employment of the recommended mitigation measures, the proposed development could be undertaken whilst maintaining the core landscape character of the area with a acceptable Visual Impact on the surrounding character.



# 10.0 References and Bibliography

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