Visual Impact Assessment
Nyngan Solar Plant

Nyngan, NSW

FRESH
landscape design

REPORT

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Contents

Executive summary

AGL Energy Limited (AGL) has been selected by the Australian Government as the successful applicant in the solar photovoltaic (PV) category of the Solar Flagships Program independent reassessment process. Under the Program, AGL will construct two solar plants at Nyngan and Broken Hill in New South Wales (NSW).

This Visual Impact Assessment (VIA) report for the Nyngan Solar Plant describes the results of the fieldwork, records the existing landscape character, documents the assessment of visual impact of the proposal and makes recommendations for mitigation measures. The VIA is one of a suite of environmental assessments that form part of the Environmental Impact Statement for the project.

The methodology for this VIA has two major components: a baseline study and an impact assessment. The baseline study is an inventory of the existing visual character and the ways in which views are experienced in the places from where the development could be visible. The visual impact assessment describes, for the available views, the changes in visual character and visual amenity that are expected to result from the development.

The proposed project site is located on rural land in Central West NSW, approximately 10km west of the Nyngan township within the Bogan Shire local government area. The site is a cleared, relatively flat area of farmland surrounded by shelterbelts of mature trees and shrubs. The area surrounding the site is predominantly large holdings engaged in rural activities with low population density. The nearest non-involved residential dwelling is approximately 2.7km from the proposed project.

The key elements of the proposed development are:

- solar arrays with a total capacity of up to approximately 106 megawatts (MW) on approximately 300 hectares of land
- a 132kV transmission line, approximately 3 km in length including a crossing at the Barrier Highway and connection into the existing Nyngan – Cobar 132kV transmission line
- a substation
- an operations and maintenance building, construction offices and parking
- site fencing
- unsealed access tracks.

Public consultation by others identified views of the Bogan River as being valued. There was no public concern identified about visual impacts resulting from the proposed development. The photovoltaic panels are designed to absorb sunlight so reflectivity is not expected to be a problem.

The proposed development is not expected to be visible from Nyngan, the Bogan River, peri-urban areas, local tourist and recreation facilities, rural areas east of the Bogan River or the Mitchell Highway.

The flat terrain of the study area, the tree lines along three sides of the site and the relatively low profile of the proposed infrastructure would result in the solar plant being hidden from view for the rural lands to the west, north and east of the site. The solar plant would be visible from parts of the Barrier Highway through gaps in the roadside vegetation but the 1.5km offset of the solar plant from the highway and the low profile of the solar plant will make it appear almost insignificant in height. These views can be screened by vegetation to further reduce the visual impact. The solar plant will be even less visually apparent (or not visible at all) from the rural lands to the south of the Barrier Highway.

The proposed transmission line will be more easily seen than the solar plant because the poles will be considerably higher than nearby trees and the transmission line crosses the Barrier Highway. Views to the proposed transmission line will generally be of short duration and seen from moving vehicles. The closest farmhouse is 1.8km from the transmission line and views from that house towards the transmission lines are blocked by vegetation. Views towards the transmission lines from other farmhouses will be at least partially screened by existing vegetation and the lines and

poles will appear small because of the distance of the viewer. Measures proposed to minimise visual impacts include minimising clearing of vegetation and establishing additional vegetation in strategic locations.

The proposed development of a solar plant on the identified site would have some impact on the existing landscape character in the immediate vicinity. However, in our professional opinion, the visual impact of the proposed Nyngan Solar Plant and associated transmission line described in this assessment is considered low. After vegetation has been established and matures along the southern side of the site, the visual impact of the solar plant will be negligible.

1 Introduction

1.1 Purpose of this report

AGL Energy Limited (AGL) has been selected by the Australian Government as the successful applicant in the solar photovoltaic (PV) category of the Solar Flagships Program independent reassessment process. Under the Program, AGL will construct two solar plants at Nyngan and Broken Hill in New South Wales (NSW).

Landscape architecture consultants Fresh Landscape Design were commissioned by **ngh**environmental to prepare a visual impact assessment (VIA) for the proposed Nyngan Solar Plant located approximately 8.5 kilometres from the Nyngan town centre. Fieldwork for this assessment was undertaken in May and June 2012. Maps and photomontages were provided by **ngh**environmental. Unless otherwise acknowledged, all the photographs included in this report are by Fresh Landscape Design.

The report describes the results of the fieldwork, records the existing landscape character, documents the assessment of visual impact of the proposal and makes recommendations for mitigation measures. This VIA is one of a suite of environmental assessments that form part of the Environmental Impact Statement for the project.

1.2 Objectives

The report addresses the requirements related to the preparation of a visual impact assessment for the project as outlined in the Director-General's requirements. The requirements and sections of the report that address them are listed in Table 1.1.

1.3 Assumptions

The methodology used to conduct this assessment assumes that:

- some viewing locations and views will be considered more important than others
- some viewers will be more concerned about the appearance of the landscape than others
- views seen for short periods will be considered less important than views experienced over a sustained time
- the importance of a view may be partly determined by its popularity, the number of people seeing it, the facilities provided for its enjoyment and its inclusion in tourism information
- the significance of visual effects is not an absolute measure but can be assessed for a proposed development based on consideration of landscape quality, viewer sensitivity and typical viewpoints along with the nature, scale and duration of the change
- the visual management objectives are maximum protection and maintenance of existing visual landscape character for areas of high visual quality, and restoration and enhancement of visual character for areas with low visual quality.

Table 1.1 Report requirements

Requirement	Report sections
Provide an assessment of the landscape character and values and any scenic or significant vistas of the area potentially affected by the development. This should describe community and stakeholder values of the local and regional visual amenity and quality, and perceptions of the development based on surveys and consultation.	Section 4 Section 5.2
Include a full assessment of the visual impacts associated with the solar farm, including identification and documentation of all key viewing points and corridors particularly from identified sensitive lands. This should also include the associated transmission line. Alternative pole designs should be presented and assessed and the potential for under grounding in sensitive locations should also be assessed.	Section 5
Provide an assessment of the potential for reflectivity from the panels and associated infrastructure, and any safety impacts for motorists or aircraft.	Section 5.4.2
Include photomontages of the development 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 farm.	Section 5.5 and Appendix D
Provide an assessment of the feasibility, effectiveness and reliability of proposed mitigation measures and any residual impacts after these measures have been implemented.	Section 6

2 Methodology

2.1 Overview

The method used in this study to assess the visual impacts of the proposal is based on the process developed by the Bureau of Land Management (BLM 1986) in the United States of America, known as the BLM method, and adapted for Australian conditions by Williamson and Calder (1979). This methodology is documented in the Tasmanian Forest Practices Authority's Manual for Forest Landscape Management (FPA 2006) and further developed by the Landscape Institute and the Institute of Environmental Management and Assessment in the United Kingdom (LI & IEMA 2002) and the Western Australian Planning Commission (WPAC 2007).

The methodology for this project has two major components: a baseline study and an impact assessment.

The baseline study is an inventory of the existing visual character and the ways views are experienced in the places from where the development could be visible. It involves the following steps:

- **definition of study area**
- **desk study** including collection and review of existing literature, tourism information, maps and aerial photos, review of the description of the proposed development, identification of approximate visibility of the development based on the topography (visual shadow areas and viewsheds) and identification of potential receptors of view effects (viewers) including residents, visitors and travellers through the area
- **field survey** to familiarise the consultant with the visual qualities of the study area, check the actual extent of visibility, identify key and representative viewpoints and make a comprehensive photographic record
- **visual baseline analysis** including visual quality classification of landscape character types, a summary of general viewing opportunities for the area potentially affected by the proposal, assessment of visual sensitivity and identification of visual management priorities for particular areas.

The visual impact assessment describes, for the available views, the changes in visual character and visual amenity that are expected to result from the development. It involves the following considerations:

- **identification of the views** likely to be affected by the proposal
- **identification of sensitivity** of viewers at those locations based on general principles and the results of community consultation
- **identification of visual effects** introduced by the development for key and representative viewpoints including the scale of change, level of contrast, duration, distance, angle of view affected and cumulative effects; photomontages are prepared to illustrate visual effects for viewpoints most likely to be impacted by the proposed solar plant
- assessment of **options for mitigation** of adverse visual effects
- evaluation of the **level of visual impact** and its **significance** after mitigation in relation to the visual management objectives.

2.2 Visual landscape character

Various physical factors affect the visual character of a landscape including topography, geology, climate, season, vegetation and changes made by humans through their use of the land, for example through farming or construction. The process of describing visual landscape character in this study seeks to identify areas with similar visual traits (Landscape Character Units (LCUs)). Within each LCU the landscape appearance is described in terms of landform, vegetation patterns, water

form and human land use, focusing on the elements that make the area identifiable or unique and its significance at a national, regional and local level.

2.3 Scenic quality

Scenic quality is a largely subjective rating of the visual appeal of the landscape. Typically areas with more outstanding, unusual or diverse features are most preferred while areas lacking features and variety will be least preferred. This study uses the WAPC (2007) visual landscape character preference indicators as a guide to assessing scenic quality in the study area. These indicators are summarised in Appendix A.

A high scenic quality rating (H) is allocated to areas with a good fit to the most preferred indicators. A moderate scenic quality rating (M) applies to areas with an even mix of most and least preferred indicators. A low visual scenic rating (L) is given for areas fitting best with the least preferred indicators.

2.4 Visual sensitivity

Visual sensitivity is a measure of public concern for visual quality. Depending on the number and circumstances of the viewers, the level of sensitivity will vary. In general visual sensitivity:

- decreases as the viewing time becomes shorter
- decreases as distance from the viewer to the development increases
- can depend of the activity of the viewer
- increases where a view is enjoyed and highly valued by the community
- increases where a view is seen by many viewers
- increases if the view is seen from residences
- increases if the visual landscape plays a part in tourist or recreational activities.

The methodology used for this study requires identification of travel routes such as roads, waterways and recreational tracks, and use areas such as residential areas, tourist and recreational facilities and farmhouses in the study area as likely viewing locations.

The criteria used to assess the visual sensitivity ratings for these potential viewing locations are based on the type of users, amount of use, level of public interest and adjacent land uses as defined by the Bureau of Land Management (BLM 1986):

- High sensitivity (1): high use travel routes (highways and main roads, recreation trails, tourist drives) of national or state significance, high use recreational areas such as camp grounds, picnic grounds, beaches and visitor centres, navigable rivers, streams and lakes of national or state recreational significance, residential areas with high levels of concern for scenic quality, recreational, cultural or scenic sites of national or state importance, walking tracks of national or state significance.
- Moderate sensitivity (2): main roads with moderate use, recreational, cultural or scenic sites of regional or local significance, residential areas with moderate concern for scenery, recreation trails, rivers, streams and lakes of regional or high local recreational significance.
- Low sensitivity (3): low-use sites and travel routes, duration of view is short, not important, seen by few people or partially obscured by landscape features, sites of low local significance.

Feedback from public consultation is also used to identify potentially sensitive viewpoints for the study area.

2.5 Visual landscape management objectives

Landscape areas will have different priorities and objectives for visual management depending on their distance from the viewer, scenic quality and visual sensitivity. For example, an area with high scenic quality that is close to a tourist lookout (high sensitivity) is likely to have a high management

priority and require maximum retention of scenic quality. In this VIA, visual landscape management objectives are used to assess the significance of a visual impact for a particular view.

The distance of areas from travel routes and use areas is categorised using the distance zones identified in the West Australian Planning Commission's visual landscape planning manual (WAPC 2007). These are:

- foreground (fg) 0 – 0.5 kilometres
- middle ground (mg) 0.5 – 6.5 kilometres
- background (bg) 6.5 – 16 kilometres.

For the study area, this information has been combined with ratings for:

- scenic quality – high (H), moderate (M) or low (L); and
- visual sensitivity – high (1), medium (2) or low (3)

using the decision matrix shown in Table 2.1 (based on BLM 1986) to identify areas with particular visual landscape management priorities. Any combinations not specifically listed are rated as low management priority.

Table 2.1 Decision matrix for visual landscape management priorities

		Distance zone – sensitivity rating						
		fg-1	**mg-1**	**bg-1**	**fg-2**	**mg-2**	**bg-2**	**fg-3**
Scenic quality	**H**	High	High	High	High	Moderate	Moderate	Moderate
	M	High	Moderate	Moderate	Moderate	Moderate	Low	Low
	L	Moderate	Moderate	Moderate	Moderate	Low	Low	Low

The visual management objectives for the three management priorities are described in Table 2.2.

Table 2.2 Visual landscape management objectives

Management priority	Management objectives
High	Maximum retention of visual quality. In these areas the level of landscape alteration allowed is low since these areas are the least accommodating of visual change. It is expected that developments that lead to major change in scenic quality in the short term be avoided and the focus is on maximum protection of all existing visual landscape features.
Moderate	Moderate retention of visual quality. Here the focus is on the protection of dominant existing visual landscape features and landscape alterations may be allowed to be visually apparent.
Low	Optimising and enhancing visual quality. In these areas of relatively low visual significance, landscape alterations may be visually dominant but should reflect the existing lines, forms, colours and textures of the existing landscape.

2.6 Visual effects

A series of observation points in the study area were used to sample views that might be affected by the proposed development. Of these observation points, some were selected as key viewpoints to examine two types of views:

- critical viewpoints – sensitive views from where the proposed development is likely to be highly prominent
- typical viewpoints – representing views that will be seen from many locations (such as from residential areas and roads in rural areas or from within a landscape character unit) with emphasis on selecting worst case viewing locations.

For each viewpoint the views and visual effects of the proposed development are described in relation to:

- the visual qualities of the view
- the duration and angle of the view in relation to the main activity of the viewer
- the distance of the viewpoint from the proposed development
- the extent of the area over which the changes would be visible
- the scale of the change in the view (loss or addition of features, changes in composition, proportion of view affected)
- the degree of contrast in form, scale, mass, line, height, colour and texture introduced into the view by the proposed development
- the duration and nature of the effect (temporary, permanent, intermittent)
- the numbers and types of viewers affected.

The ratings for the degree of contrast introduced by the proposed development for each viewpoint have the following definitions (BLM 1986).

- **High contrast:** the proposal would be dominant within the landscape and generally not overlooked by the observer, the visual change would not be absorbed.
- **Medium contrast:** the proposal would be moderately dominant and noticed, the visual change would be partially absorbed.
- **Low contrast:** the proposal would be seen but would not attract attention, the visual change would be well absorbed.
- **Indistinct:** contrast would not be seen or would not attract attention, the visual change would be imperceptible.

2.7 Significance of effects

The significance of visual effects for the proposed development is not an absolute measure. The methodology used in this study incorporates consideration of the landscape visual character and quality, viewer sensitivity, visual management objectives, amount and duration of contrast that would be introduced by the proposed development and the opportunities for mitigation in order to determine the significance of the visual impact.

In general:

- changes affecting large numbers of people will be more significant than those affecting a small group of viewers
- in wilderness areas the visual quality and sensitivity may be very high so the significance of change will be higher
- changes in views from recognised or important viewpoints are likely to be more significant than changes affecting less important paths and roads
- large-scale changes introducing a high level of contrast are likely to be more significant than small changes or lower contrast changes.

To determine if the visual management objectives for a viewpoint are met, the contrast rating for the viewpoint is compared with the relevant management objectives. The visual impact significance for a viewpoint is defined as:

- **High impact:** contrast is greater than what is acceptable for the visual management objectives
- **Medium impact:** contrast is acceptable for the visual management objectives
- **Low impact:** visual contrast is little or not perceived and is acceptable.

2.8 Technical details

Photographs were taken in the field using a 35mm SLR digital camera with the lens set at 55mm, which closely represents the central vision of the human eye. Locations were recorded using a handheld GPS unit.

Photomontages are digital simulations of how a view might appear with the proposed development in place. Representations of the proposed structures are superimposed onto a photograph of the view. The photomontages are an artist's representation of what the proposed

development might look like based on the proposed infrastructure at the time of preparation. Infrastructure types and locations shown in the photomontages may vary from that actually built. Vegetation removal was not included in the montages.

The visible shadow areas for the proposed solar plant and transmission line were modelled using ArcGIS 10 (3d Analyst) using a combination of field data, ground truthed NSW Land and Property Information (LPI) data and data provided by the client. A digital terrain model (DTM) was derived by using 1m contours for the site and Nyngan; local gaps were supplemented with LPI spot heights and 10m contours. ArcScene was used to develop 3D multipatches of key infrastructure and the vegetation immediately around the perimeter of the site on the western, northern and eastern boundaries.

Modelling for the visible shadow areas was based on a series of assumptions. Vegetation along the southern boundary of the site was patchy so in the model it was assumed that this vegetation did not exist. The vegetation in the shelterbelts around the western, northern and eastern boundaries of the site was measured in the field to be 11-15m high, however a conservative approach was adopted by allowing for 10m high vegetation. Other calculations (assumptions) for the model included: solar array (3m high), transmission poles (21m high) located at vertices and spaced approximately 150m along the proposed alignment, building (3m high) and substation (4m high).

The DTM was also converted to a 10m resolution raster for viewshed analysis within 16km. The distance limit is based on the extent of the background distance zone. The raster incorporated the infrastructure and vegetation multipatch heights thereby including them in the viewshed modelling. The viewshed analysis allowed for a viewer height of 1.5m and used default earth curvature and light refraction settings.

3 Project description

The proposed project site is located on rural land in Central West NSW, approximately 10km west of the Nyngan township (refer to Appendix B Map 1) within the Bogan Shire local government area. The site has an elevation of approximately 175 to 178m above sea level and is a cleared, relatively flat area of farmland surrounded by shelterbelts of mature trees and shrubs. The area surrounding the site is predominantly large holdings engaged in rural activities with low population density. The nearest non-involved residential dwelling is approximately 2.7km from the proposed project.

The key elements of the proposed development are:

- solar arrays with a total capacity of up to approximately 106 megawatts (MW) on approximately 300 hectares of land
- a 132kV transmission line, approximately 3 km in length including a crossing at the Barrier Highway and connection into the existing Nyngan – Cobar 132kV transmission line
- a substation
- an operations and maintenance building, construction offices and parking
- site fencing
- unsealed access tracks.

3.1 Solar arrays

The arrays would be approximately 2 metres in height, consisting of photovoltaic (PV) modules that are black on the front and grey on the back, mounted on steel post and rail support structures (see Figure 3.1). The ground surface under the arrays would be natural vegetation, which would be mowed as required.

Figure 3.1 Typical solar arrays (image courtesy First Solar)

3.2 Substation

The substation would be located in the southwest corner of the project area (refer to Appendix B Map 1). It would include a busbar, circuit breakers, current transformers, voltage transformers, and a 33/132kV transformer. It would be surrounded by gravel. The configuration of the substation is unknown but it is assumed that it will be similar in height and visual character to other substations found in Australia (see Figure 3.2).

Figure 3.2 Typical substation found in Australia

3.3 Transmission line

It is proposed to construct the transmission line using spun concrete poles with 6 circuit wires and 2 earth wires. Figure 3.3 shows a typical example of the type of pole although the design of the pole top may vary. A communications wire may also be incorporated into the line. In general the poles are proposed to be 21m high and approximately 150m apart. Taller poles (26m high) are proposed for the Barrier Highway crossing and where the proposed transmission line crosses an existing 66kV transmission line. In these locations the poles may be closer together (approximately 90m spacing). The transmission line would connect the onsite substation to the existing Nyngan – Cobar 132kV transmission line.

An easement will be needed along the transmission line. This easement is expected to be 40m wide and would be kept clear of trees and large shrubs.

Figure 3.3 Example on left of spun concrete poles and wires (image provided by AGL)

3.4 Site office and maintenance building

The temporary construction site offices and permanent operations and maintenance building would be prefabricated steel ATCO huts or similar (see Figure 3.4) that would contain offices, facilities, and a site control centre. The colours of the roof and walls are not known.

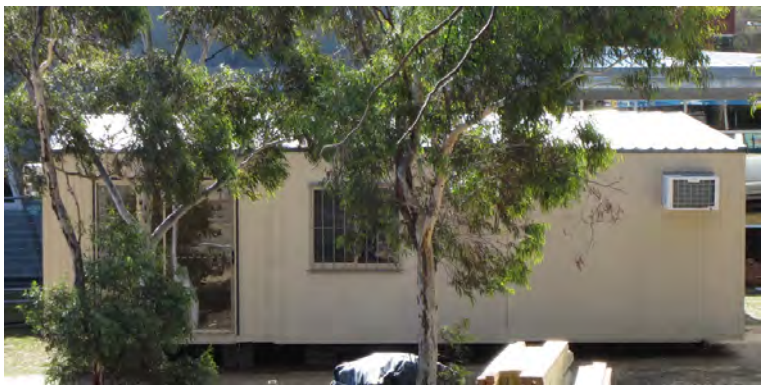

Figure 3.4 Typical prefabricated steel site office

3.5 Site fencing

Site fencing would be Type 2-Y-B/B-T security fencing including top and bottom rails, straight posts, and 1800mm high heavy-duty chain wire fabric with 3 rows of barbed wire along the top. The fence would be located around the perimeter of the solar arrays (see Figure 3.5 for example of similar fence)

Figure 3.5 Example of site fence (top of posts may be straight instead of angled)

3.6 Access tracks and parking

An access road would be constructed between the Barrier Highway and the plant site along an existing farm track. The road would be unsealed compacted gravel to accommodate vehicle movements during construction. The access road would be approximately 8m wide.

Internal access tracks would be provided for site maintenance. These would be 6m wide and made from local gravel or soil.

Access for construction of the section of transmission line to the south of the Barrier Highway would similarly use existing tracks where possible, with new temporary tracks provided where needed for construction.

A parking area would be constructed within the solar plant site boundaries to accommodate all staff vehicles.

4 Existing visual character

4.1 Definition of the study area

The proposed development is located in rural lands near the town of Nyngan in the central plains of New South Wales. The rural lands of the district are mainly used for production of wool, wheat and cattle. Further afield there are mining enterprises and the Macquarie Marshes, an extensive area of wetlands.

The area was originally occupied by the Ngiyambaa people with the first European visitor recorded in 1835. The town of Nyngan beside the Bogan River was established around 1882 after the Main Western railway line was constructed. This railway line now carries mainly freight traffic and the town is served by the Barrier Highway and the Mitchell Highway. The Bogan River is used for recreational activities such as canoeing, bird watching, fishing, water skiing and picnics.

The area studied for this project has been limited to within 16 kilometres of the proposed development (refer to Map 1, Appendix B). The distance limit is based on the extent of the background distance zone (WAPC 2007) in relation to the project site.

4.2 General viewing opportunities

Map 2 (Appendix B) shows the location of travel routes, waterways and land uses within the study area. This information was compiled from maps, fieldwork and Geographical Information System (GIS) data primarily from NSW Land and Property Information (online) and Bing (ESRI Online). Tourism publicity material was used to identify sites of tourism activity. Residential areas and farm properties were identified using GIS data and aerial photography. The study area contains a network of low-use local roads and ephemeral, non-trafficable waterways. Table 4.1 lists the general viewing opportunities for the study area and their expected level of sensitivity based on their level of use, type of use and significance at national, state, regional or local level.

Table 4.1 Viewing opportunities and expected sensitivity

Opportunity	Description	Sensitivity level
Urban residential areas	Nyngan town	High (1)
Peri-urban residential areas	Large block residential development on the southern and north-eastern edges of the town of Nyngan and along the western side of the Bogan River	High (1)
Highways	Mitchell Highway, Barrier Highway	High (1)
Rivers	Bogan River and Peter Sinclair Bridge	High (1)
Tourist and recreation areas	Rotary Park, Nyngan Golf Course, Riverside Caravan Park	Moderate (2)
Peri-urban non-residential areas	Showground, race course, airport, cemetery	Moderate (2)
Rural areas	Scattered houses and farmland with views of long duration	Moderate (2)
Railways	Main Western line (used for freight)	Low (3)
Local roads	Minor sealed and unsealed roads with low volume of traffic and minimal tourist interest	Low (3)
State forests	Miandetta State Forest, Thorndale State Forest, minimal access and minimal tourist interest	Low (3)

4.3 Descriptions of landscape character

For the purposes of examining the visual qualities of the study area at a local level, the study area was divided into five landscape character units (LCUs) based on the results of the desktop analysis and fieldwork. Map 3 (Appendix B) shows the location of the LCUs. The area within each LCU has similarities in terms of landform, vegetation patterns, water form and land use patterns which are described below along with an assessment of scenic quality.

4.3.1 LCU1: Nyngan town

Landscape character	Scenic quality
Landform: Wide, flat plain with little variation in topography except for the levee bank between the town and the Bogan River **Vegetation:** Trees, shrubs and grass present in streets, scattered parks, well maintained gardens are situated in main street **Water:** Bogan River is a significant water body nearby but not visible from the town, no other water structures evident **Natural areas:** Built areas of town do not impinge on river foreshores, remnant vegetation not obvious **Colour:** Patchy colour with greens and neutral colours of the vegetation contrasting with the brighter colours of the buildings and dark grey asphalt roads **Scarcity:** town is of local significance to community as service centre for farming activities, visual qualities are similar to other towns in the region **Human land use:** Land is used for residential purposes and associated retail and services **Built characteristics:** Area is divided by roads and fences into rectangular blocks with individual houses and associated structures. Buildings are generally one storey with painted walls and steel or tiled roofs. Alignment of fences, houses and utility poles all create linear, repeating patterns along streets. Views limited to along roads. Railway station museum is a historic feature.	Moderate scenic quality (M)

4.3.2 LCU2: Nyngan peri-urban

Landscape character	Scenic quality
Landform: Wide, flat plain divided by wide expanse of Bogan River **Vegetation:** Heavily treed along banks of river to create overhead enclosure, other areas mainly grassed with scattered trees, soft edge between cleared land and remnant vegetation **Water:** Bogan River dammed to form a wide, reflective expanse of water **Natural areas:** Some intrusion of structures related to recreational activities along river banks, but strong appearance of naturalness along the river compared to the rest of the study area **Colour:** Drab greens and neutral colours of vegetation dominate **Scarcity:** Bogan River has local and regional significance as a water body **Human land use:** Mixed use including tourism and recreational activities related to river (camping, picnics, barbecues, water skiing, canoeing, bird watching), sporting activities (ovals, racetrack, golf course), industrial services (railway, farming services, airport) and large residential/rural residential blocks. **Built characteristics:** Farm style houses and associated buildings scattered randomly through small grassed paddocks (large residential blocks/small farms), sometimes appearing poorly maintained and in a mix of styles; larger scale industrial structures in other areas in a mix of styles and visually dominant, riverside park areas contain small structures such as timber picnic tables, shelters and bollards and many patches of bare ground **Agricultural characteristics:** Some appearance of small scale grazing activity but no distinctive visual patterns	High scenic quality (H) along Bogan River banks Moderate scenic quality (M) elsewhere

4.3.3 LCU3: Bogan River and floodplain

Landscape character	Scenic quality
Landform: Wide, flat floodplain divided by shallow channels **Vegetation:** Largely cleared to grasslands with scattered trees, other areas with rounded forms of remnant trees and shrubs, generally lower and denser than in the Rural plans LCU and incorporating fine textured *Callitris* spp. **Water:** Bogan River is the main watercourse but ephemeral creeks, shallow water channels and shallow ponds are scattered throughout, many areas appear boggy and prone to flooding **Natural areas:** Natural areas with dense vegetation along creek line seen as complex pattern of patches of grey green and drab olive green from tree canopies to ground **Colour:** Dominance of neutral colours (seasonal) and expanse of blue sky, reddish soil along roadsides **Scarcity:** Bogan River has local and regional significance, Macquarie Marshes further northeast have regional significance **Human land use:** Grazing for sheep and cattle, large flat expanses of grassland divided by dark lines of trees **Built characteristics:** Criss-crossed with lines of farm fences and transmission lines mostly built from timber	Moderate scenic quality (M)

4.3.4 LCU4: State forests

Landscape character	Scenic quality
Landform: Sloping gently up from surrounding plains **Vegetation:** Heavy tree cover with drab green canopies and dark vertical lines of tree trunks dominating; dense, fine textured, rounded shrubs shortening views to about 10m; groundcover patchy with areas of reddish bare soil **Water:** Not evident **Natural areas:** Semi natural appearance **Colour:** Drab greens, dark brown trunks, reddish soil **Scarcity:** Not distinctive **Human land use:** Forestry, no recreational uses apparent **Built characteristics:** little built form evident other than roads	Moderate scenic quality (M)

4.3.5 LCU5: Rural plains

Landscape character	Scenic quality
Landform: Flat, wide plain **Vegetation:** Largely expanses of fields ploughed for crops divided by straight, dark lines of remnant trees, longer grass and rounded forms of shrubs along roadsides **Water:** Not evident **Natural areas:** Abrupt transitions from remnant vegetation to fields **Colour:** Likely to be seasonal patchwork of colour from crops **Scarcity:** Not distinctive **Human land use:** Rural farmlands used primarily for pasture and grain crops **Built characteristics:** Flat plains criss-crossed with lines of farm fences and powerlines, scattered farmhouses and associated farm buildings evident but well offset from roads, rows of round hay bales **Agricultural characteristics:** LCU will be subject to ephemeral variations resulting from cropping cycles	Moderate scenic quality (M)




4.4 Visual management priorities

Based on the decision matrix in Table 2.1, the visual management priorities for the study area have been determined as follows.

Table 4.2 Visual management priorities in the study area

Visual management priority	Areas identified
High	Within 500m of Barrier Highway, Mitchell Highway, Bogan River, Nyngan and surrounding peri-urban areas
Moderate	All parts of study area not mentioned
Low	In State forest LCU

For the proposed development, the area within 500m of the Barrier Highway crossing is an area of high visual management priority and the visual effects of this part of the development will need careful management. The remainder of the proposed development is in areas of moderate visual management priority where a small amount of visual effect may be acceptable.

5 Visual impact assessment

5.1 Introduction

The baseline study in the previous section of this report identified visual landscape management priorities for the study area. These priorities were derived by combining information about scenic quality, likely public sensitivity and the distance of the area from viewing opportunities. Each zone has associated objectives to guide management of visual change and to help evaluate project proposals.

The purpose of the visual impact assessment is to evaluate the proposed development by determining the degree of visual change introduced into the landscape by the proposal and whether this is appropriate to the character of the landscape and public viewing circumstances as summarised by the visual landscape management priorities. The visual impact of the proposal is first reviewed by considering the general impacts of the whole development. A more detailed assessment is then made for key viewpoints.

The aims of this process are to avoid or limit visual exposure of the proposal, particularly from sensitive public viewpoints and to ensure that where the proposal is visible it is well integrated into the visual landscape.

The visual impact assessment makes an assessment of the extent of visual impact of the proposal. It does not conclude whether the visual impact is acceptable or not to the individual viewer as that judgement is subjective and depends on the viewer. Differences in personal perceptions of landscapes are accounted for in a general sense in this assessment by assuming that visual sensitivity has three components:

- dominance of exposure to the view
- duration of exposure to the view
- likely relationship of the user to the environment.

For example, a resident who looks across at nearby power poles and lines every day will have a substantially different viewing experience from a motorist crossing beneath the same transmission line while travelling to their destination elsewhere. Other factors that will contribute to visual sensitivity include: personal meaning attached to the landscape; personal feeling of inspiration and interpretation derived from the landscape; diversity, composition and accessibility of the landscape; lack of change (timeless quality); and a sense of grandeur and integrity (Australian Greenhouse Office 2005).

5.2 Public consultation and highly valued views

Community consultation for the visual impact assessment was undertaken as part of the overall project planning process and is documented in *Community Consultation Plan Nyngan Solar Plant* (prepared by **ngh**environmental for AGL, June 2012), which is included as Appendix C of the Environmental Impact Statement. The consultation process included face to face meetings with nearby residents as well as communication with the broader community through Council, advertisements, a project website and feedback forms. The results of the community consultation process are summarised in section 7.4 of the Environmental Impact Statement.

From the results of the community consultation so far, there appears to be little concern in the local community about the visual impacts of the proposed development. Views of the Bogan River where nominated as being of special value in the Nyngan area.

Following the precautionary principle, the following views in the study area have been identified as being likely to be valued more highly by the community using the methodology outlined by WAPC (2007):

- views out of the recreation areas around the Bogan River including from the Peter Sinclair Bridge, Rotary Park, Riverside Caravan Park and Nyngan Golf Course
- views out of residential areas of Nyngan
- views out of individual farm houses.

Given the flat terrain of the study area, there are few opportunities for views from elevated locations which are often highly valued and there are no tourist lookouts.

5.3 Opportunities to view the proposed solar plant and transmission line

5.3.1 Visible shadow areas

Visible shadow areas (refer to Map 4 in Appendix B) are the parts of the study area where it is predicted that the proposed development will not be visible because there are hills, ridges or specific blocks of vegetation between the viewer and the proposal that block the view. Areas not in visible shadow are considered to be in the viewshed. For this visual impact separate visible shadow areas have been mapped for the proposed solar plant and the proposed transmission line because the two structures are distinctly different in height and location.

The viewshed analysis provided in this report is a worst-case scenario and does not include vegetation and other screening (apart from the tree lines along the western, northern and eastern boundaries of the site). As the contour interval data was relatively poor for this assessment and the heights of infrastructure were comparatively low, the viewshed results should be considered as indicative only.

In the field it was observed that the vegetation lining most roadsides and edges of paddocks throughout the rural areas restricts viewing opportunities.

5.3.2 General viewing opportunities

The following is a summary of observations about general opportunities to view the proposed solar plant and transmission line in the study area. Refer to Map 4 in Appendix B for the location of the foreground, middle ground and background zones for the proposed development.

Table 5.1 Opportunities to view the proposed development

Location	Nature of views to solar plant	Nature of views to transmission line
Barrier Highway	When travelling along the highway, roadside vegetation and tree lines narrow views to along the road corridor with some fleeting glimpses across paddocks through gaps in the vegetation. Roadside vegetation near the solar plant is relatively sparse and allows longer duration views across paddocks towards site of solar plant.	Transmission line crossing highway potentially visible from up to 8km when travelling west and 500m when travelling east. Views to transmission line from further away when travelling east along the highway are likely to be partially screened by vegetation. When travelling west, views to the northern section of line are relatively open within 800m of crossing point.
Mitchell Highway	Fleeting views across paddocks interrupted by roadside vegetation and tree lines. Solar plant in background zone unlikely to be visible behind tree lines.	When travelling south-east, fleeting glimpses to transmission line in background may be possible through gaps in roadside vegetation

Local roads in Rural LCU	Roadside vegetation limits views to fleeting glimpses across paddocks. Some longer views available looking west from Bogan Road West. Views to solar plant likely to be blocked by surrounding vegetation.	Roadside vegetation limits views to fleeting glimpses across paddocks. Some longer views available looking west across paddocks from Bogan Road West.
Local roads in Bogan River and floodplain LCU	Long views to west restricted by vegetation in foreground. Views along roads are directed away from solar plant.	Long views to west restricted by vegetation in foreground. Views along roads are directed away from transmission line.
State forests LCU	Views within forests are restricted to approximately 10m by vegetation. No obvious recreation places or lookout points.	Views within forests are restricted to approximately 10m by vegetation. No obvious recreation places or lookout points.
Nyngan LCU	Views to west restricted by levee bank and vegetation along Bogan River.	Views to west restricted by levee bank and vegetation along Bogan River.
Nyngan peri-urban LCU	Views to west from eastern part of LCU restricted by levee bank and vegetation along Bogan River. Longer views available from western part of LCU are partially blocked by vegetation and solar plant in background zone is unlikely to be visible.	Views to west from eastern part of LCU restricted by levee bank and vegetation along Bogan River. Longer views available from western part of LCU are partially blocked by vegetation. Visual attention is largely focused towards the river (away from the transmission line).
Recreational areas around Bogan River	Views focused towards the river. Long views blocked by trees around river.	Views focused towards the river. Long views blocked by trees around river.
Farm houses in middle ground zone	Views of long duration towards solar plant are screened by tree lines along roads, between paddocks and around solar array	Views of long duration towards transmission line are partially screened by dense tree lines.
Farm houses in background zone	Views of long duration across paddocks. Solar plant likely to be completely screened by existing vegetation.	Views of long duration across paddocks, often partially blocked by vegetation surrounding houses. Views to transmission lines in background likely to be partially or completely screened by tree lines.

5.4 General impacts

5.4.1 Solar plant general impacts

The solar plant has a number of components with different visual qualities.

- The dark, non-reflective nature of the solar array and relatively transparent visual character of the security fence are expected to help minimise their visual contrast with the surrounding landscape despite their industrial character. Their horizontal scale is consistent with the large paddocks in the rural LCU.
- Depending on their size and colour, the temporary construction buildings and permanent operations and management building are likely to introduce another visual contrast but on a relatively small scale and somewhat consistent with other rural infrastructure in the area. Removal of the temporary construction facilities at the end of the construction phase will help to reduce the visual contrast.
- Depending on the final design, the light grey colour and industrial form and size of the substation are likely to introduce a stronger and discordant visual contrast.
- The unsealed access roads will contrast in colour with surrounding vegetation but are visually consistent with other rural access roads in the vicinity and the colour will match the colour of the frequently ploughed paddocks nearby.

The solar plant is low in profile relative to nearby vegetation and the site for the solar plant is surrounded on three sides by lines of dense trees and shrubs. The solar plant is unlikely to be visible from outside the site on the western, northern and eastern sides (see visible shadow areas in Map 4, Appendix B) because of screening by the vegetation along the boundaries of the site. While Map 4 shows that in theory the solar plant will be visible in the foreground and middle ground zones to the south of the site, existing vegetation scattered through this area will screen part or all of the solar plant in views from many locations. In addition, for viewers more than 500m away from the solar plant, the reduction in apparent size of the solar plant brought about by distance will mean that it appears to be of insignificant height in the view if seen at all (refer to photomontage V17 (Appendix D) for an illustration of the visual contrast at approximately 500m).

5.4.2 Reflectivity of photovoltaic panels

Photovoltaic panels are designed to absorb sunlight and convert it to electricity. Minimising the light reflected from the panels is a goal of panel design, manufacture and installation. AGL has provided the following information from First Solar about reflectivity for the proposed photovoltaic panels.

'Glare and dazzle effects due to reflection from First Solar modules are expected to be minimal and comparable to glass facades. The First Solar modules appear darker than silicon modules in nearly all conditions. This dark appearance is direct evidence that the reflected light from the First Solar modules is less than that from silicon modules.'

The full application note from First Solar including reflection coefficients is provided in Appendix C of the visual impact assessment report.

The photovoltaic panels will be located more than 1.5km from the primary view corridor (Barrier Highway) with public views into the site. Views from the highway are expected to be directed towards the back of the panels rather than the active surface. This arrangement is expected to further minimise opportunities for glare and reflectivity for viewers located at ground level in the public realm.

5.4.3 Transmission line general impacts

The study area is criss-crossed by transmission lines, mainly using timber poles but concrete poles are also present. Existing poles are generally of a similar height or lower than the trees along roadsides and between paddocks. Lattice towers were not observed other than for several telecommunications towers.

The poles proposed for the new transmission line are considerably higher than the existing vegetation and the tops of the poles may be seen above the treetops from locations relatively close to the transmission line. The light colour and narrow width of concrete poles is likely to help the poles blend into the sky when seen in the middle ground or background.

The flat terrain avoids the possibility of the transmission lines appearing on ridgelines where their visual impact could be increased. The main factor affecting the visibility and impact of the transmission lines in this flat terrain is the proximity of the viewer to the transmission line and presence or absence of screening vegetation. The transmission lines are expected to introduce insignificant contrast into views where the viewer is more than 1km from the transmission line due to the reduction in apparent size of the poles brought about by distance. Views to the transmission lines from less than 1km are likely to be partially screened in many cases by vegetation.

5.4.4 Options for transmission line poles

Other options for a 132kV transmission line are steel poles, lattice towers and undergrounding.

- Steel poles are generally thinner than concrete poles. Their reflective surface when new increases their visual contrast for approximately two years until the metal surface dulls. Their visual impact for this project is unlikely to be significantly different from concrete poles after the first two years since the poles will almost always be viewed from a distance where the material will be indistinguishable.
- The level of visual contrast introduced by using lattice towers for the transmission line would be considerably higher than for concrete or steel poles. Lattice towers are a geometric and industrial form not usual in the study area and generally not preferred by viewers consulted in other studies and should be avoided for this development.
- Undergrounding transmission lines delivers an insignificant visual contrast in the long term. However, given the relatively low visual impact of the proposed transmission line, the high cost of undergrounding the transmission line does not appear justified.

5.5 Visual impact from specific locations

The locations selected as viewpoints for sensitive and representative views are identified on Map 5 in Appendix B and are the likely visual impacts of the proposed solar plant and transmission line are described in detail below.

An object will appear smaller when it is further from the view and larger when it is closer. To assist with understanding how large the transmission line poles at various distances will appear relative to the rest of the view, calculations have been carried out using photographs of poles of known height at known distances using the same camera focal length as used for the viewpoint photos. All photos in this section of the report are printed at the same scale as the poles shown in Figure 5.1, so that the size of the poles in this figure can be used as a rough guide to the size that the poles might appear in the viewpoint photo if they were visible. These calculations only estimate size and do not consider the effects of colour or screening on the potential visibility of the poles.

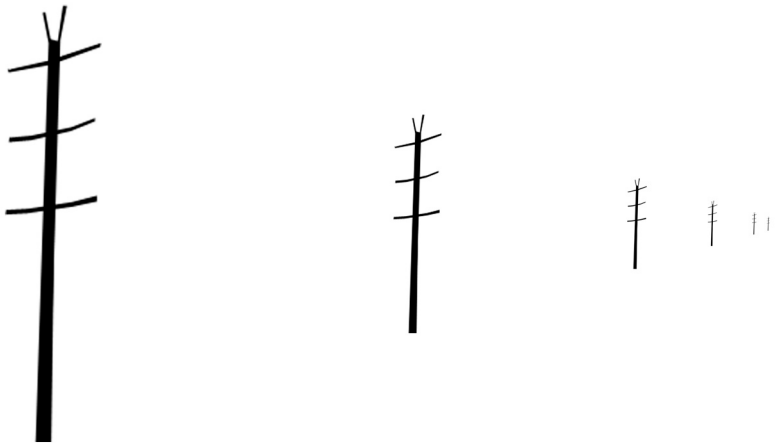

Figure 5.1 Indicative pole sizes for viewer distances (left to right) of 100m, 200m, 500m, 1km, 2km and 3km scaled to match viewpoint photos in this report

V1 Mitchell Highway South

Location	Mitchell Highway 5km south east of Nyngan (towards Dubbo)
Reason for selection	Typical viewpoint for southern part of Mitchell Highway and Bogan River and Floodplain LCU seen by many viewers from moving vehicles
Description	Views dominated by flat grassy paddocks, interspersed with informal clumps of trees, and the broad expanse of sky. Dense stands of *Callitris sp*. and roadside vegetation block restrict long views. Views off to sides of road largely fleeting from moving vehicles. Longer duration views available to farm workers.
Visual management priority	High
Distance to proposal	14km
Visual analysis of proposal	The solar plant is unlikely to be visible since this viewpoint is in a visual shadow area as well as in the background zone. While theoretically visible, the transmission line is unlikely to be seen because of screening by vegetation in the foreground and middle ground and the insignificant size that the transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V2 Nyngan-Mundaroo Road

Location	Nyngan-Mundaroo Road approximately 2.3km north-east of Nyngan
Reason for selection	Typical viewpoint for Bogan River and Floodplain LCU on regional road in northern part of LCU, seen by people from moving vehicles
Description	Water lies in shallow channels in the flat grassy plain divided by informally arranged groups of native trees and shrubs. Built structures are insignificant. Views of short duration seen by a small number of people from moving vehicles, longer duration views for farm workers.
Visual management priority	Moderate
Distance to proposal	10km
Visual analysis of proposal	The viewpoint is in the visible shadow area for the solar plant. While theoretically visible, the transmission line is unlikely to be seen because of screening by vegetation in the foreground and middle ground and the insignificant size that the transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V3 Tottenham Road

Location	Corner of Tottenham Road and Oatley Street, Nyngan
Reason for selection	Typical view from eastern edge of Nyngan from behind levee bank seen by residents
Description	View is dominated by broad, horizontal mass of grassed levee bank and broad expanse of sky. Views to river are obscured with only tree tops showing above the levee bank. View experienced for short duration from moving vehicles, moderate duration for pedestrians and longer duration for views from houses along Tottenham Road.
Visual management priority	High
Distance to proposal	8km
Visual analysis of proposal	The levee bank will screen views of solar plant and transmission lines from this viewpoint. Even if viewers were to stand on top of the levee bank, the solar plant and transmission line are unlikely to be seen because of screening by vegetation in the foreground and middle ground and the insignificant size that the proposed structures would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Insignificant contrast
Visual impact significance	Low impact

V4 Nyngan Golf Club

Location	On levee bank near clubhouse, off Moonagee Street
Reason for selection	Recreation area on western edge of Nyngan that is likely to be sensitive
Description	Elevated view from top of levee bank to modified park-like setting with mown grass and randomly scattered trees. Trees along fairways and riverbank create a dark, drab backdrop across the horizon. Similar views could be seen from clubhouse and golf course by golf players and social visitors.
Visual management priority	High
Distance to proposal	8.5km
Visual analysis of proposal	The solar plant and transmission line are unlikely to be seen because of screening by vegetation between fairways and along the river in the foreground and the insignificant size that the transmission line and solar plant would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V5 River Street, Nyngan

Location	River Street
Reason for selection	Worst case viewing location for Nyngan LCU seen by residents
Description	As for Tottenham Road (V3), the long horizontal mass of the levee bank screens views to river and beyond with only the tops of trees in the foreground zone visible above the bank. Similar views could be seen by residents for extended periods from houses.
Visual management priority	High
Distance to proposal	8.3km
Visual analysis of proposal	The levee bank will screen views of solar plant and transmission line from this viewpoint.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V6 Peter Sinclair Bridge, Bogan River

Location	Mitchell Highway crossing Bogan River
Reason for selection	Potentially sensitive view from highway and water body in recreation area close to Nyngan, and northern entry point to town, often seen by people in moving vehicles, pedestrians and horse riders
Description	Wide, reflective expanse of river is the focal point of the view. Trunks along the riverbanks create pattern of vertical lines below a mass of drab, weeping foliage. Trees in the foreground narrow longer views to just along the highway.
Visual management priority	High
Distance to proposal	8.5km
Visual analysis of proposal	Vegetation obscures middle ground and background. Longer view along the highway are directed away from the site of the solar plant and transmission line. Even without screening by vegetation, at this distance from the proposed development, the solar plant and transmission line would appear insignificant in size.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V7 Barrier Highway – Riverside Caravan Park

Location	Caravan Park entry road
Reason for selection	Worst case typical viewpoint for large residential blocks and tourist facility in Nyngan peri-urban LCU closest to proposed development, seen fleetingly by visitors from moving vehicles and for longer duration by residents. This view is less restricted by roadside vegetation than other areas nearby.
Description	View is dominated by flat grassy plain with dark bands of trees in straight lines between paddocks. Rural farmhouses provide focal point and visual interest. Wooden poles and wires contrast in size, direction and scale.
Visual management priority	High
Distance to proposal	7.7km
Visual analysis of proposal	While theoretically visible, the transmission line and solar plant are unlikely to be seen because of screening by vegetation in the foreground and middle ground and the insignificant size that the solar plant and transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V8 Bogan Road West

Location	Bogan Road West, 1.4km south from Barrier Highway
Reason for selection	Worst case typical veiwpoint in Nyngan peri-urban LCU, relatively close to transmission line and with less vegetation along road and in paddocks, seen fleetingly from moving vehicles
Description	The view is dominated by the broad, flat paddocks that have been frequently ploughed to remove vegetion. This flat expanse is punctuated by power poles and scattered clumps of trees. Similar views of long duration may be seen from farmhouses in the vincinty.
Visual management priority	High
Distance to proposal	7.2km
Visual analysis of proposal	This viewpoint is in the visible shadow area for the solar plant. While theoretically visible, the transmission line is unlikely to be seen because of the insignificant size that the transmission line would appear at this distance.
Mitigation opportunities	Not needed
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V9 Tullamore-Nyngan Road

Location	Tullamore-Nyngan Road approximately 1.8km south from Nyngan
Reason for selection	Typical viewpoint in Bogan River and floodplain LCU in area closest to proposed development, seen fleetingly from vehicles
Description	Rounded forms of trees and shrubs in a variety of drab greens dominate and restrict the view to the foreground.
Visual management priority	Moderate
Distance to proposal	8.2km
Visual analysis of proposal	This viewpoint is in the visible shadow area for the solar plant. While theoretically visible, the transmission line is unlikely to be seen because of screening by vegetation in the foreground and the insignificant size that the transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V10 Mitchell Highway - Wilgaree

Location	Wilgaree driveway on Mitchell Highway
Reason for selection	Worst case typical viewpoint for northern section of Mitchell Highway in Rural Plains LCU seen fleetingly from moving vehicles on busy national highway and for longer duration from farms
Description	Sky and broad, flat paddocks dominate and are divided by dark, drab lines of trees. Paddocks are frequently ploughed to show reddish brown colour of soil. Vertical lines of power poles and horizontal lines of wires traverse the view in the foreground. Farm fences add to the horizontal character of the view.
Visual management priority	High
Distance to proposal	5.2km
Visual analysis of proposal	This viewpoint is in the visual shadow area for the solar plant. While theoretically visible, the transmission line is unlikely to be seen because of screening by vegetation in the foreground and middle ground and the insignificant size that the transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V11 Pangee Road

Location	Pangee Road approximately 7km west of Tullamore-Nyngan Road
Reason for selection	Typical viewpoint in southern part of Rural Plains LCU seen fleetingly from small number of moving vehicles and for longer duration from farms
Description	Broad, flat grassy plain is divided by dark, straight lines of trees. Roadside vegetation in the foreground adds variety and frames longer views.
Visual management priority	Moderate
Distance to proposal	13.8km
Visual analysis of proposal	While theoretically visible, the transmission line and solar plant are unlikely to be seen because of screening by vegetation and the insignificant size that the solar plant and transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V12 Miandetta

Location	Miandetta State Forest, near corner of Gilgai Road and Barrier Highway
Reason for selection	Typical and worst case scenario for State Forests LCU seen fleetingly from small number of moving vehicles
Description	Rounded, fine textured forms of shrubs contrast with dark vertical lines of tree trunks and reddish brown colour of soil. Dense vegetation restricts views to the foreground zone.
Visual management priority	Low
Distance to proposal	9.8km
Visual analysis of proposal	This viewpoint is in the visual shadow area for the solar plant. While theoretically visible, the transmission line is unlikely to be seen because of screening by vegetation in the foreground and the insignificant size that the transmission line would appear at this distance.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V13 Redlands house

Location	Redlands property, Barrier Highway
Reason for selection	Closest non-involved house, with views from house of long duration
Description	Views from the front of the house are directed east to north-east. Trees and shrubs close to the house dominate the view and filter longer views across the flat paddock. Views to the middle ground and background are obscured by a dense line of trees in foreground running across the view.
Visual management priority	Moderate
Distance to proposal	2.7km
Visual analysis of proposal	The viewpoint is in the visual shadow area for the solar plant which will be well hidden behind two tree belts running across the view. The tree line, approximately 300m east from the viewpoint and running across the view in the foreground, blocks line of sight to the proposed transmission line from this viewpoint. From the house the transmission line will not be visible with the existing vegetation left intact. Note: if a viewer were to look from the paddock on the eastern side of the closest tree line (300m east from house), the top of the transmission line would be visible above the tops of trees in the tree belt running alongside the transmission line route. This view is not available from the house.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

V14 Pic's paddock, Redlands

Location	Redlands property, Barrier Highway
Reason for selection	Potential house site in middle ground zone, could have views of extended duration from future farmhouse, indication of potential visual effect for farmlands north of Barrier Highway
Description	Viewing location is slightly elevated from surrounding flat plain with panoramic views to the east towards proposed development. Flat, ploughed fields punctuated by scattered trees with a dark, horizontal band of trees along horizon (approximately 2.6km from viewpoint). The broad expanse of the flat ground plain and wide expanse of sky dominate the view.
Visual management priority	Moderate
Distance to proposal	2.6km
Visual analysis of proposal	This viewpoint is in the view shadow area for the solar plant which will be hidden behind the tree line running across the horizon. This view is broad and open with little screening effect provided by vegetation other than the band of trees along the horizon. The top half of the transmission line, particularly the poles, will be visible above the tops of the trees along the horizon. Given the distance to the transmission line, the poles will appear relatively small in scale and feint. Refer to the photomontage V14 in Appendix D for a simulation of the expected visual contrast.
Mitigation opportunities	Not required. There are no definite plans to build a house on this site and tree planting would interrupt farming activities. The visual contrast would be well absorbed so tree planting is not warranted.
Contrast rating	Low contrast
Visual impact significance	Low impact

V15 Barrier Highway line crossing

Location	Barrier Highway near transmission line crossing
Reason for selection	Transmission line crosses national highway, fleeting views from moving vehicles in close proximity to transmission line, easement clearing and entry road
Description	Trees and shrubs along sides of road narrow view to road corridor. Rounded forms of tree canopies and vertical and angled lines of tree trunks are dominant visual elements. Fleeting views to northwest across paddocks through gaps in vegetation are characterised by flat, ploughed paddocks divided by dark, horizontal lines of trees. Fleeting views to southwest through gaps in vegetation feature the straight line of railway track running horizontally across the foreground in front of the rounded, fine textured forms of dense green vegetation, which restricts views to approximately 200m.
Visual management priority	High
Distance to proposal	200m to road crossing, 1.8km to substation and solar plant
Visual analysis of proposal	The solar plant is unlikely to be noticed from this viewpoint because the main direction of the view does not include the solar plant location. For the view along the road corridor: the transmission line wires will be visible against the sky where they cross over the highway but the poles are likely to be hidden by the roadside vegetation except in the immediate vicinity of the crossing. The visual contrast created by the wires is likely to be minor given that they introduce only thin horizontal lines across a view dominated to thick tree trunks and dense canopies. Refer to photomontage V15 in Appendix D for a simulation of the expected visual effect. For the view to the north-west seen fleetingly through the gaps in the roadside vegetation: the poles will be significantly taller than the line of trees (approximately double the height) and along with the wires will introduce a clearly visible contrast in colour and form. The new dirt access track will introduce less visual contrast since bare earth is already visible in the paddocks and in other dirt tracks in the vicinity. The transmission line easement clearing is unlikely to be noticeable since the land is already cleared to grass level. The substation and site office also may visible in the middle ground. The colour and industrial form of the substation are uncommon in the area and introduce a visually discordant element. The size and colour of the site office will affect its capacity to blend into the surrounding landscape. For the view to the south-west seen fleetingly through gaps in roadside vegetation: clearing of the transmission line

	easement will create a geometric gap in the trees and shrubs that will be clearly evident in the foreground. The poles will also be clearly visible and contrast significantly in height and form with the surrounding vegetation.
Mitigation opportunities	1. Offset poles as far as possible from both sides of highway to minimise perceived height of nearest poles (feasible and reliable result). 2. Use shorter poles for the transmission line (approximately 15m high is desirable) to reduce the contrast in height between the poles and the existing trees (feasibility subject to detail design requirements, reliable visual effect). 3. Establish endemic trees and shrubs to fill gaps in roadside vegetation (either along roadsides or inside paddocks) to screen views towards transmission line (feasible but screening effect will take years to develop and plantings may fail). 4. Minimise clearing for easement on southern side of highway and retain shorter shrubs where possible (feasible but requires co-operation from landowner and authorities). 5. Establish strategically located endemic trees and shrubs to screen views from highway to substation and site office. 6. Select a dark, neutral colour for the site office walls and roof to assist them to blend with dark colours of nearby tree canopies. Options 1, 3, 4, 5 and 6 in combination are feasible and would be effective in time, leaving minimal visual impact.
Contrast rating	Medium contrast without mitigation Low contrast with mitigation measures 1 + 3 + 4 + 5 + 6 Low contrast with mitigation measures 1 + 2 + 4 + 5 + 6
Visual impact significance	Low impact with mitigation

View looking west along road

View looking northwest seen fleetingly through gaps in roadside vegetation

View looking southwest seen fleetingly through gaps in roadside vegetation

V16 Tikkara house

Location	Tikkara property, Barrier Highway
Reason for selection	Farmhouse closest to solar plant and transmission line
Description	The farmhouse is surrounded by trees and shrubs with the most open views looking from the front of the house across the broad, flat paddocks to the east. Views to the north and south are screened by large blocks of existing vegetation.
Visual management priority	Moderate
Distance to proposal	1.8km
Visual analysis of proposal	Views to the solar plant will be obscured by the extensive belt of trees and shrubs 100m to the north. Views to the southern section of the transmission line are expected to be screened by the vegetation around the house and the large block of trees and shrubs 1km to the west.
Mitigation opportunities	Not required
Contrast rating	Indistinct contrast
Visual impact significance	Low impact

View looking east from front of house

V17 Barrier Highway - Tikkara

Location	Tikkara entry on Barrier Highway
Reason for selection	Worst case scenario for view from Barrier Highway to solar plant, fleeting views seen from moving vehicles
Description	This view is perpendicular to the direction of travel along the highway and is seen through a large gap in the roadside vegetation. The flat surface of the paddock is interrupted by scattered trees and shrubs. Distant views terminate at the tree line along the northern boundary of the solar plant site.
Visual management priority	High
Distance to proposal	1.5km
Visual analysis of proposal	The solar array may be just discernable running across in front of the trees on the horizon due to its dark colour and wide spread. The fence is not likely to be seen at this distance because its relatively transparent design and small apparent height will help it to blend into the surrounding scenery. The substation and buildings towards the left hand side of the view will be screened by the clump of trees in the foreground. Photomontage V17 in Appendix D shows the expected level of visual contrast. The transmission line is not expected to be visible from this viewpoint because of the direction of the view and screening by trees in the foreground.
Mitigation opportunities	1. Establish endemic trees and shrubs in gaps in roadside vegetation immediately adjacent to site. 2. Establish screening shrubs, growing to at least 2m high, along the southern edges of the solar plant
Contrast rating	Low contrast without mitigation Indistinct contrast anticipated within two to three years with either mitigation option
Visual impact significance	Low impact

5.6 Cumulative impacts

Cumulative visual impacts are assessed by reviewing the visual integrity and form of other built structures within the visual catchment of the proposed solar plant and transmission lines. Structures with similar scale and dominance are identified as having a level of visual impact that together with the proposed infrastructure will have a cumulative visual effect.

The proposed solar plant is unique in the visual catchment. Other rural and industrial style structures are scattered through the landscape but are unlikely to be seen in the same view with the solar plant. The cumulative visual impact resulting from adding the solar plant would be minor to insignificant.

Transmission lines are visible in most parts of the study area. They are generally constructed from timber poles that are similar in height to nearby trees so that they are not visible from long distances. The greatest accumulation of poles is found in the streets of Nyngan where many power and light poles are located along the verges but these poles will not be visible in views that include the proposed transmission line. Given the screening effects of the nearby vegetation on existing transmission lines near the site and the relatively low visual impact of the proposed transmission lines, the cumulative visual impact of the proposed transmission lines would be minor.

5.7 Summary of visual impacts

The proposed development is not expected to be visible from Nyngan, the Bogan River, peri-urban areas, local tourist and recreation facilities, rural areas east of the Bogan River or the Mitchell Highway.

The flat terrain of the study area, the tree lines along three sides of the site and the relatively low profile of the proposed infrastructure would result in the solar plant being hidden from view for the rural lands to the west, north and east of the site. The solar plant would be visible from parts of the Barrier Highway through gaps in the roadside vegetation but the 1.5km offset of the solar plant from the highway and the low profile of the solar plant will make it appear almost insignificant in height. These views can be screened by vegetation to further reduce the visual impact. The solar plant will be even less visually apparent (or not visible at all) from the rural lands to the south of the Barrier Highway.

The proposed transmission line will be more easily seen than the solar plant because the poles will be considerably higher than nearby trees and part of the transmission line will be close to the Barrier Highway These views to the proposed transmission line will generally be of short duration and seen from moving vehicles. The closest farmhouse is 1.8km from the transmission line and views from that house towards the transmission lines are blocked by vegetation. Views towards the transmission lines from other farmhouses further away will be at least partially screened by existing vegetation and the lines and poles will appear small and feint because of the distance of the viewer.

The access track entry from the Barrier Highway will also be fleetingly visible to passing traffic. Provided that the access track is constructed from local materials in similar colours to other access roads in the vicinity, the track will have a low visual impact.

Overall the visual impact of the proposed development is of low significance. Table 5.2 summarises the specific findings from key viewpoints.

Table 5.2 Summary of significance of visual impacts

Viewpoint	Visual impact significance	Comments
V1 Mitchell Highway South	Low	Development barely visible if seen at all
V2 Nyngan-Mundaroo Road	Low	Development unlikely to be seen
V3 Tottenham Road	Low	Development unlikely to be seen
V4 Nyngan Golf Club	Low	Development unlikely to be seen
V5 River Street, Nyngan	Low	Development unlikely to be seen
V6 Peter Sinclair Bridge, Bogan River	Low	Development unlikely to be seen
V7 Barrier Highway – Riverside Caravan Park	Low	Development unlikely to be seen
V8 Bogan Road West	Low	Development barely visible if seen at all
V9 Tullamore-Nyngan Road	Low	Development unlikely to be seen
V10 Mitchell Highway - Wilgaree	Low	Development barely visible if seen at all
V11 Pangee Road	Low	Development unlikely to be seen
V12 Miandetta	Low	Development unlikely to be seen
V13 Redlands house	Low	Development barely visible if seen at all
V14 Pic's paddock, Redlands	Low	Top of poles barely visible above distant tree line
V15 Barrier Highway line crossing	Low	Poles and wires visible close to crossing point, mitigation suggested
V16 Tikkara house	Low	Development unlikely to be visible
V17 Barrier Highway - Tikkara	Low	Solar plant barely visible in distance, mitigation suggested

6 Recommendations

6.1 Impact mitigation

Screening vegetation has been suggested to mitigate the minor visual impact of the solar plant and transmission line in views from the Barrier Highway. Figure 6.1 identifies proposed locations for this vegetation which could be established either by allowing regeneration of endemic plant species to occur or by planting. Either method is feasible, can be achieved within private property and will be effective in rendering the solar plant almost unseen from the road once the vegetation has grown to 3m in height. Glimpses of the transmission lines will still be possible after mitigation.

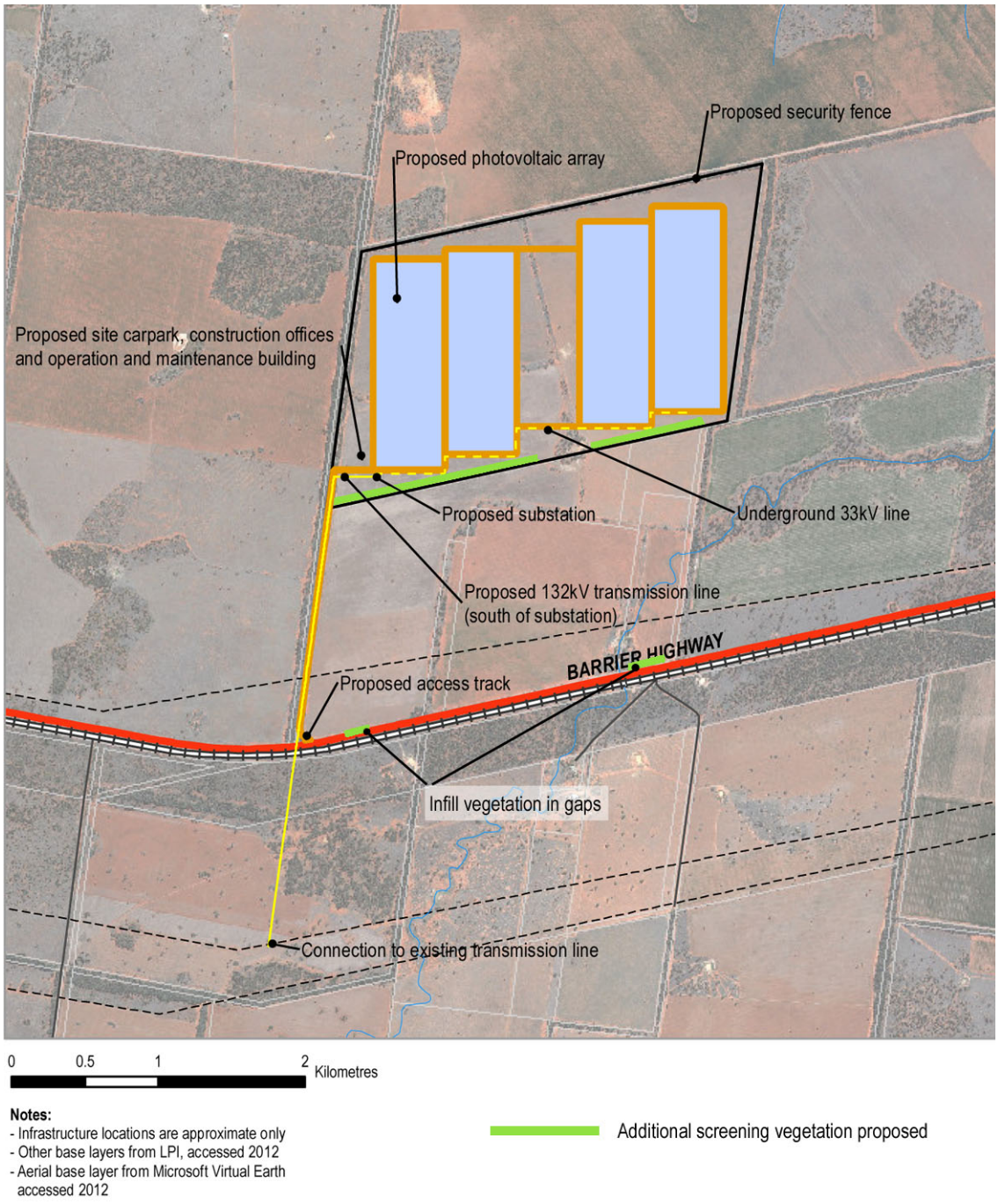

Figure 6.1 Suggested locations for additional screening vegetation

6.2 Clearing and rehabilitation

Clearing should be kept to a minimum. In particular, the tree lines on the western, northern and eastern boundaries of the site should be retained intact and the transmission line route placed to allow this to occur. This VIA assumes that there will be no clearing of trees or shrubs in these tree lines.

All areas disturbed by the construction of the proposed transmission line and solar plant should be allowed to naturally regenerate and be monitored to ensure that regeneration has occurred. Where natural regeneration is unsuccessful, revegetation should be undertaken.

6.3 Solar plant

The colour of above ground structures, including the construction site offices, should be sympathetic to the landscape character of the site to minimise visual contrast.

6.4 Transmission line

Careful placement of poles near the Barrier Highway crossing could help to reduce their visual impact. General principles to achieve this include where possible:

- setting poles as far back as possible from the road where the transmission line crosses the road
- arranging the poles so that the transmission line crosses roads at right angles
- locating poles where they can be screened from view by existing vegetation (and adding screening vegetation where needed).

6.5 Conclusion

The proposed development of a solar plant on the identified site would have some impact on the existing landscape character in the immediate vicinity. However, in our professional opinion, the visual impact of the proposed Nyngan solar plant and transmission line described in this assessment is considered low. After vegetation has been established and matures along the southern side of the site, the visual impact of the solar plant will be negligible.

7 References

Australian Greenhouse Office, Australian Wind Energy Association & Australian Council of National Trusts (2005) Wind Farms and Landscape Values: Stage One Final Report: Identifying Issues. Australian Greenhouse Office, Canberra.

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Williamson, D.N. and Calder, S.W. (1979) 'Visual Resource Management of Victoria's Forests: A New Concept for Australia'. *Landscape Planning* (6) 313-341. Elsevier Scientific Publishing Company, Amsterdam, The Netherlands.

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Appendix A: Visual landscape quality indicators

The following frames of reference for visual quality are derived from the WAPC visual landscape character preference indicators (WAPC 2007 Appendix 7).

Natural areas

Quality indicator	Most preferred	Least preferred
Perceived naturalness	High degree of perceived naturalness	Disturbed areas with little evidence of naturalness
Topography	Dramatic topography, ruggedness, rock outcropping, outstanding ridgelines and beach forms	Areas of soil erosion (especially human–induced)
Vegetation	Distinctive vegetation patterns, diverse species composition, height, colour, texture, age and density	Areas of diseased, dead or dying vegetation, severe weed infestations
Water bodies	Water bodies present (waterfalls, rivers, estuaries, oceans, lakes, inundated areas)	Water bodies with degraded banks, weed infestations, stagnation, eutrophication, algae or litter
Colour	Distinctive displays of colour in soils, seasonal vegetation, topography, rock formations or water bodies	Evidence of mining (gravel pits, sand mines)
Dramatic landforms	Unusually expansive landforms or vast horizontal scale (desert landscapes, beach and dune fields, rolling hills), distinctive landscape features (reefs, geological formations, ranges, cliff faces, rocky outcrops)	
Distinctive vegetation	Unique plants or plant combinations	
Seascapes	Combinations of ocean, reefs, beach, dunes, coastal rocks and coastal vegetation	
Outstanding combinations	Outstanding combination of landform, vegetation patterns and water features in one place	
Ephemeral features	Areas frequently prone to ephemeral events (fauna, water or wave conditions, climatic events)	

Rural landscapes

Quality indicator	Most preferred	Least preferred
Natural areas	Distinctive remnant vegetation along streams, roads and paddocks (parkland cleared paddocks), gradual transition zones between agricultural land and natural landscape	
Topography	Topographic variety and ruggedness	Areas of soil erosion (especially human–induced) or dryland salinity
Vegetation	Agricultural patterns, colours and textures that complement natural features	Areas of diseased, dead or dying vegetation, severe weed infestations
Water bodies	Water bodies present (dams, lakes, inundated areas) that borrow location, shape, scale and edge configuration from natural elements	Water bodies with degraded banks, weed infestations, stagnation, eutrophication, algae or litter
Structures and land use	Settlement patterns and individual structures that strengthen the local rural character (silos, windmills, water tanks, historic buildings, bridges, hay stacks and dams)	Evidence of mining (gravel pits, sand mines), plantations, utility towers, roads, fencing, tips, dumps and landfill areas, structures in state of disrepair, unmanaged roads and access tracks, jetties that are closed or not maintained
Outstanding combinations	Significant landscape features (trees and tree groups, historic relics, old shearing sheds, some windmills and areas of unusual topographic variation)	
Ephemeral features	Areas frequently prone to ephemeral events (fauna, distinctive crop rotations, water and climatic conditions)	

Urban landscapes

Quality indicator	Most preferred	Least preferred
Natural areas	Built developments do not impinge on dominant natural features (river foreshores, coastal landscapes), design takes account of landscape features, vegetation and landform	
Topography	Elevated landforms and undulating terrain, presence of natural rock features (cliffs, rocky outcrops)	Areas of soil erosion (especially human–induced)
Vegetation	Presence of trees, greenery, parks, gardens, street trees, median strip vegetation, well maintained gardens	Lack of vegetation
Water bodies	Water bodies present and well maintained (dams, lakes, inundated areas), open drains with complementary appearance to surrounding built form	poorly maintained waterways and drains prone to weed infestations, stagnation, pollution and littering
Structures	Complementary and diverse building styles in neighbourhoods, community artworks present, multi-storey buildings maintain the CBD character and allow views, industrial buildings in one area (industrial parks and buffers), services underground to reduce cabling, unobtrusive mobile phone and other utility towers, unobtrusive advertising	Trees heavily pruned to accommodate overhead services, intrusive overhead cabling, utility towers and billboards, derelict or rundown residential and industrial areas, large carparks without trees, buildings that contrast sharply with surrounding built character (large isolated shopping centres, apartments, hotels)
Urban design	Historic features including land uses that strengthen the local urban character, incorporation of significant cultural and environmental features into urban design, development sites designed to strengthen local character and promote a sense of community, design takes account of landscape features	Grafitti, arterial highways with strip commercial and light industrial developments without trees or other vegetation, extensive areas of urban sprawl lacking vegetation or public open space, extensive retaining walls along roadways resulting in concrete canyon effect, buildings that create a solid wall (no gaps or views between)

Appendix B: Maps

Map 1 Location and layout of proposed development

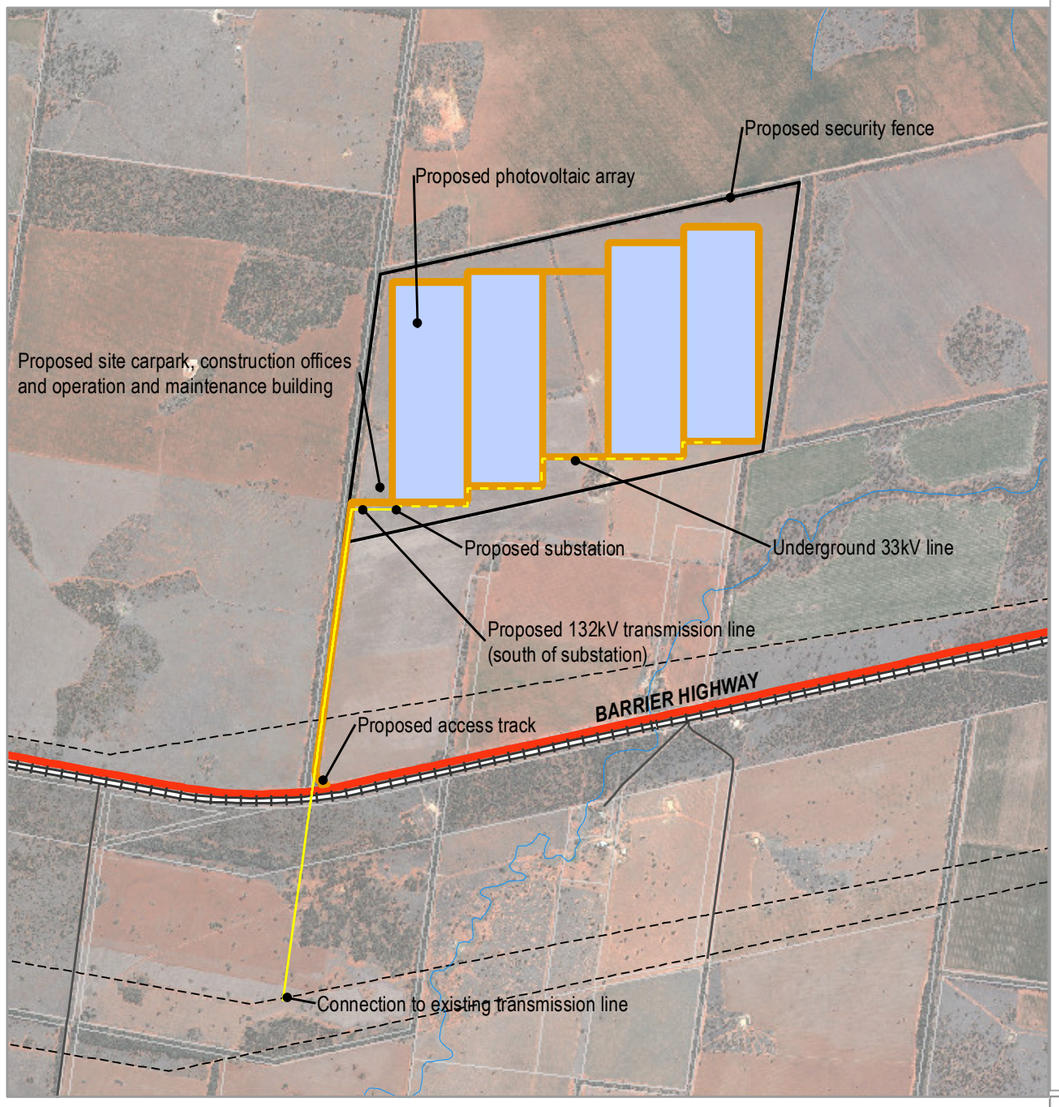
NYNGAN SOLAR PLANT
Visual Impact Assessment

SITE LOCATION RELATIVE TO NYNGAN

0 5 10 20 Kilometres

Notes:
- Infrastructure locations are approximate only
- Other base layers from LPI, accessed 2012
- Aerial base layer from Bing (ESRI Online) accessed 2012

SITE LAYOUT



0 0.5 1 2 Kilometres

Notes:
- Infrastructure locations are approximate only
- Other base layers from LPI, accessed 2012
- Aerial base layer from Microsoft Virtual Earth accessed 2012

- Proposed underground 33 kV transmission line
- Proposed 132 kV transmission line
- Proposed access road
- Rail
- Highway
- Built up area (Nyngan)
- Road
- Drainage line
- Existing powerline
- Development site (security fence)
- Proposed arrays

Ref: 4554v1.4 VIA
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Map 2 Study area and general views

NYNGAN SOLAR PLANT
Visual Impact Assessment

- Place of interest
- Rural building(s)
- Rail
- Highway
- Built up area (Nyngan)
- Road
- Existing powerline
- Watercourse
- Development site (security fence)
- Proposed underground 33 kV transmission line
- Proposed 132 kV transmission line
- Proposed infrastructure
- 16km from study area

Notes:
- Impact areas were derived from 'AGL - Nyngan Solar Power Station.dwg' provided by the client
- Other base layers from LPI, accessed 2012
- Aerial base layer from Bing (ESRI Online) accessed 2012

0 0.5 1 2 Kilometres

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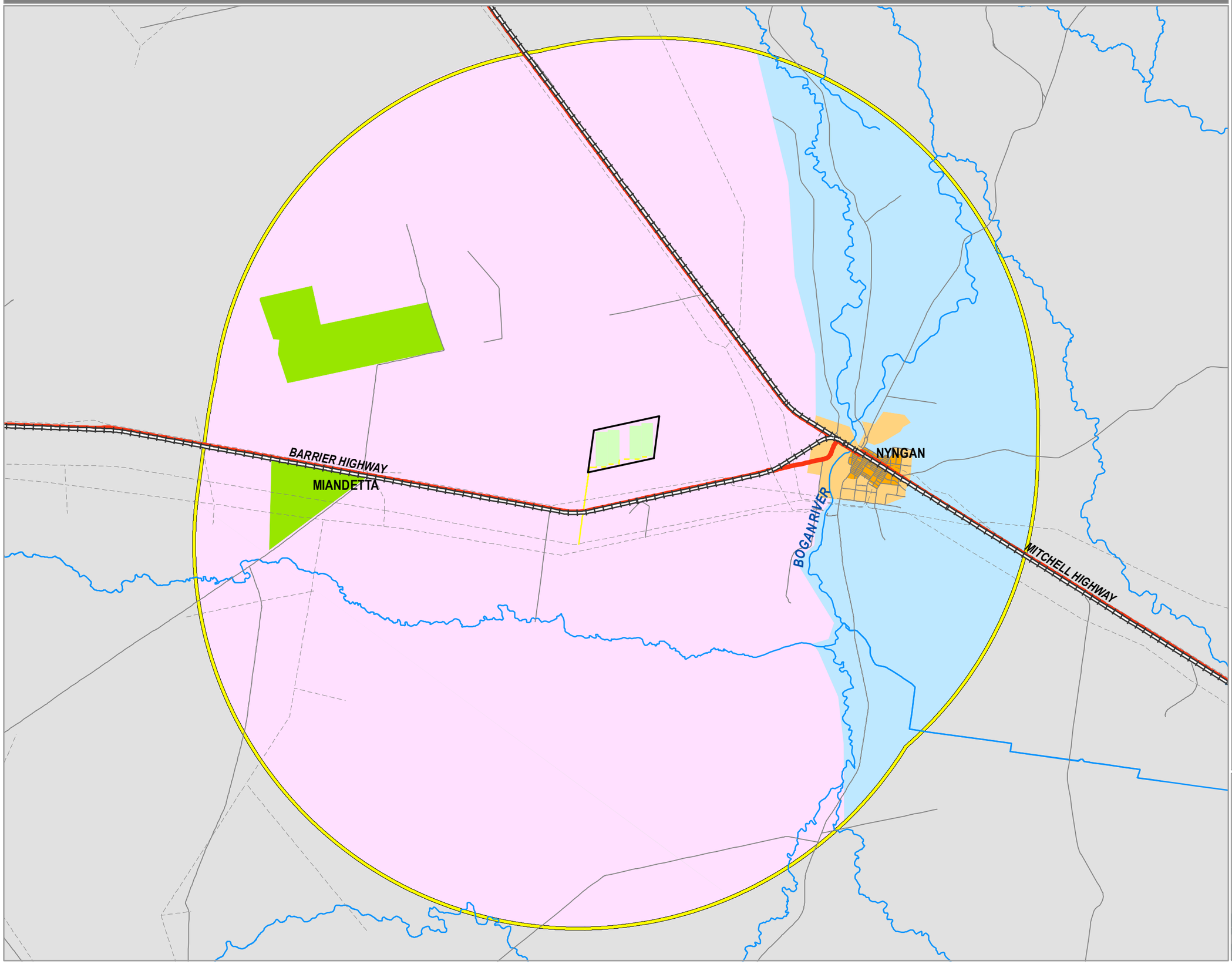
Map 3 Landscape character units identified for the study area



NYNGAN SOLAR PLANT
Visual Impact Assessment

- Rail
- Highway
- Road
- Existing powerline
- Watercourse
- Development site (security fence)
- Proposed underground 33 kV transmission line
- Proposed 132 kV transmission line
- Proposed infrastructure
- 16km from study area

Landscape Character Unit (LCU)

- Bogan River and floodplain LCU
- State Forest LCU
- Nyngan periurban LCU
- Nyngan town LCU
- Rural plains LCU

Notes:
- Impact areas were derived from 'AGL - Nyngan Solar Power Station.dwg' provided by the client
- Other base layers from LPI, accessed 2012
- LCU from Fresh Landscape Design fieldwork (2012)

0 0.5 1 2 Kilometres

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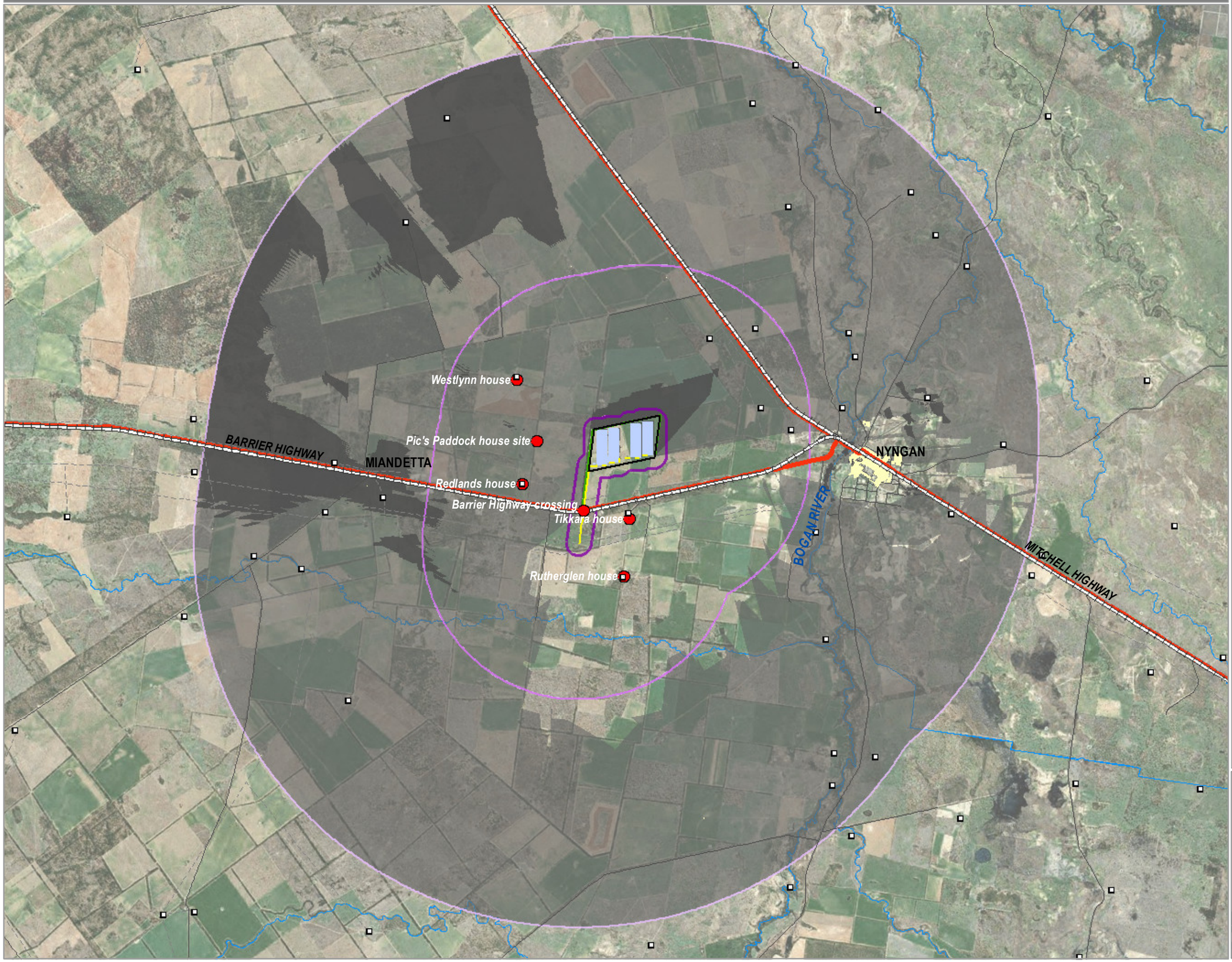
Map 4 Types and locations of views to the proposal



NYNGAN SOLAR PLANT
Visual Impact Assessment

- Rural building(s)
- Potential sensitive views
- Development site (security fence)
- Proposed underground 33 kV transmission line
- Proposed 132 kV transmission line
- Existing screening vegetation
- Proposed infrastructure
- Rail
- Highway
- Built up area (Nyngan)
- Road
- Existing transmission line
- Foreground (up to 500m)
- Middle ground (500-6.5km)
- Background (6.5km up to 16km)

Proposed transmission line
- Visual shadow area
- Visible

Proposed infrastructure; no poles
- Visual shadow area
- Visible
- Watercourse

Notes:
- Impact areas were derived from 'AGL - Nyngan Solar Power Station.dwg' provided by the client
- Other base layers from LPI, accessed 2012
- Aerial base layer from Bing (ESRI Online) accessed 2012

0 0.5 1 2 Kilometres

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Map 5 Viewpoints and observation points

NYNGAN SOLAR PLANT
Visual Impact Assessment

- 1 Viewpoints
- Other observation points
- Rail
- Highway
- Built up area (Nyngan)
- Road
- Existing powerline
- Watercourse
- Proposed underground 33 kV transmission line
- Proposed 132 kV transmission line
- Development site (security fence)
- Proposed infrastructure
- 16km from study area

Notes:
- Impact areas were derived from 'AGL - Nyngan Solar Power Station.dwg' provided by the client
- Other base layers from LPI, accessed 2012
- Aerial base layer from Bing (ESRI Online) accessed 2012

0 0.5 1 2 Kilometres

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Map 6 Photomontage locations

NYNGAN SOLAR PLANT
Visual Impact Assessment

- Photomontage viewpoint
- Proposed underground 33 kV transmission line
- Proposed 132 kV transmission line
- Development site (security fence)
- Proposed access road
- Proposed infrastructure
- Rail
- Highway
- Drainage line
- Existing powerline

Notes:
- Impact areas were provided by the client
- Other base layers from LPI, accessed 2012
- Aerial base layer from Bing (ESRI Online) accessed 2012

0 0.25 0.5 1 Kilometres

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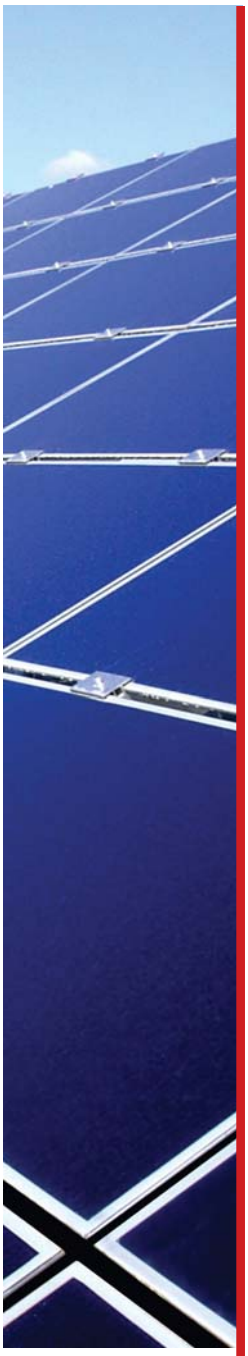
Appendix C: Technical note on photovoltaic panel reflectivity



Application Note
Reflection Behavior of FS Series PV Modules

Purpose

This document is intended to provide guidance on expected reflection effects exhibited by FS Series PV modules.

Reflection Behavior

The reflection of a glass surface is highly dependent on the angle of incidence and surface conditions. Figure 1 shows the behavior of the module surface reflection as calculated with simply modeled glass-air interfaces. It is shown that as the angle of incidence increases, the amount of reflected light also increases. It is further shown that the amount of reflected light remains below 10% for angles of incidence below 50°. Both specular reflection (image reflection) and diffuse reflection are exhibited by the module, with the intensity of the specular reflection being influenced heavily by angle-of-incident light striking the module. Typical soiling of the module surface will further reduce the observed reflection. Figure 2 shows the diffuse spectral reflectance exhibited by a First Solar FS Series PV module over wavelengths from 350 to 800nm.

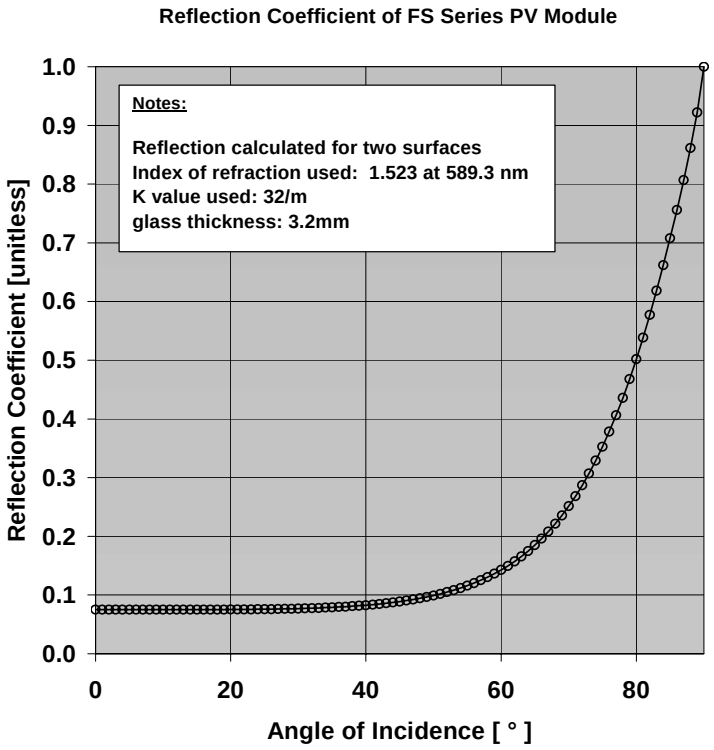


Figure 1. Reflection versus angle of incidence. Behavior is dominated by difference in the indices of refraction at the air/glass interfaces.

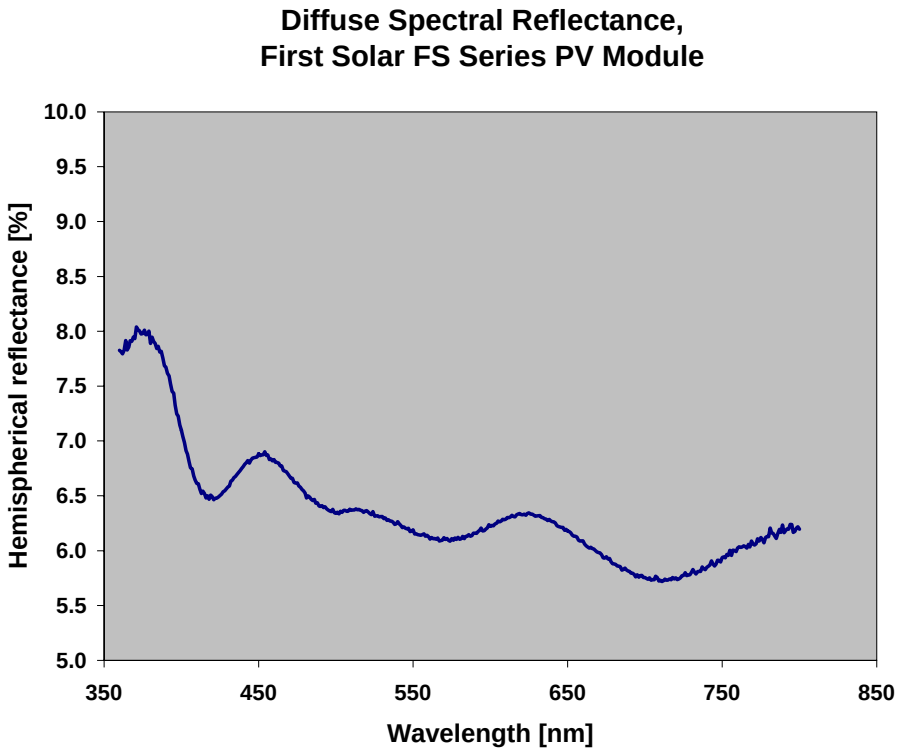


Figure 2. Diffuse spectral reflectance, as measured with a spectrophotometer with an integrating sphere attachment.

Conclusions

Glare and dazzle effects due to reflection from FS Series solar modules are expected to be minimal and comparable to glass facades. The First Solar modules appear darker than silicon modules in nearly all conditions. This dark appearance is direct evidence that the reflected light from the First Solar modules is less than that from the silicon modules. For site-specific determination of reflection and dazzle behavior in expected deployment conditions, consultation of a subject matter expert is recommended.