

AGL

Broken Hill Solar Plant

ENVIRONMENTAL ASSESSMENT

Volume 5 – Appendix C Part 2

October 2012

6. Local and Regional Landscape Context

This chapter provides a description of the broader landscape context of the project site and its associated values. Amenity value which is attached to a particular landscape may be derived from cultural, historical, social, and environmental factors and contribute to the community and general public's sense of place at that location. A development within a highly valued landscape will potentially have a much greater visual impact than one which is placed in a landscape which is not as highly valued. In addition, developments will vary in compatibility between different landscape contexts, visually and also because of the associations they may conjure within observers. For example, a large industrial development adjacent to a scenic coastal village could be seen to be out of character with its context and may attract strong opposition. There may also be perceptions of other environmental issues which are prompted by its visual presence, whether or not that may be the case.

The landscape within the study area was qualitatively assessed through an examination of existing and future industrial developments and local and regional landscape values to ascertain the compatibility of the solar project and transmission line within this context. These topics are discussed in the following sections. The outcomes are summarised at the end of the chapter and these outcomes have also been used to formulate the overall conclusion.

6.1 Landscape Implications of Current and Future Industrial Developments

This section outlines some current industrial activities which are occurring within the study area and its vicinity that have modified the landscape. Some consideration is also given to proposed developments which may have an impact on the landscape in future. The objective of this investigation is to determine how the proposed solar project and transmission line will integrate with this background context and whether they are compatible with current and future landscape attributes. Figure 41 shows a regional map with the location of current and proposed industrial developments; namely mining developments, Silverton Wind Farm and Broken Hill Mineral Separation Plant.

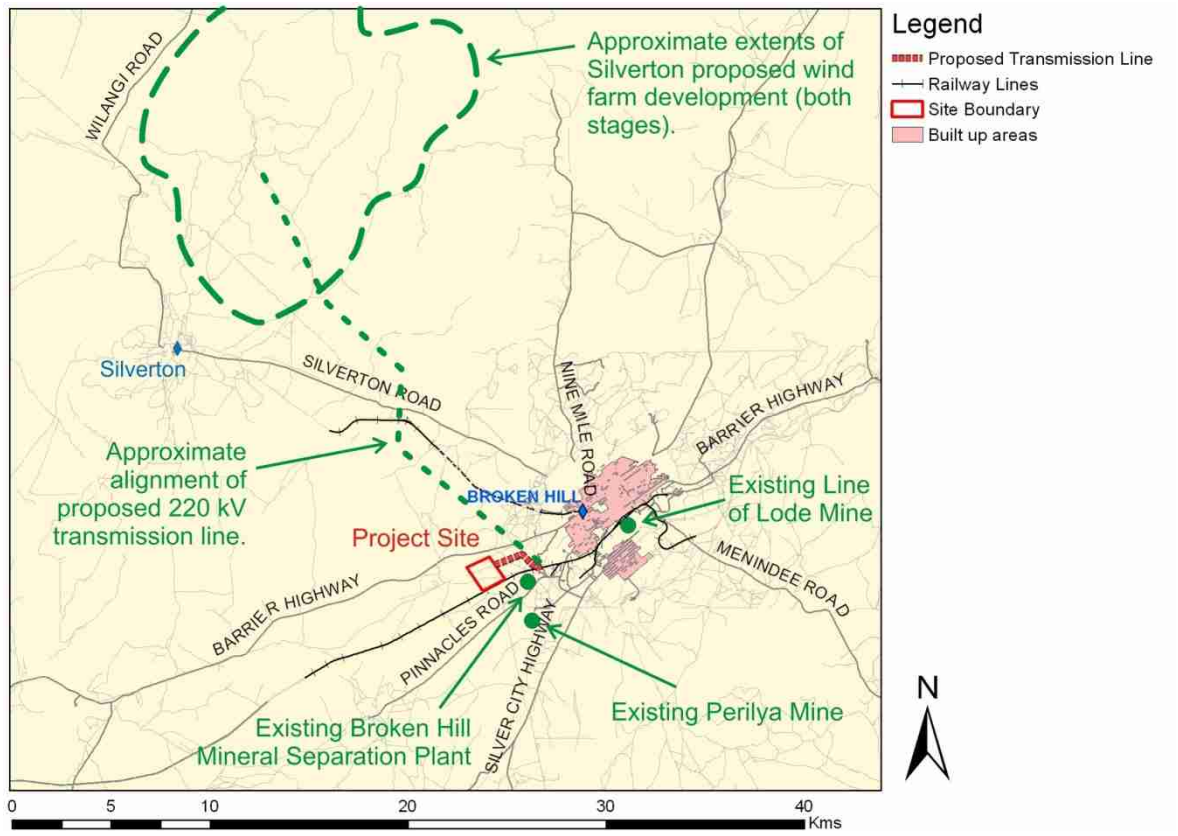

Figure 41 Existing and proposed developments.

These existing and proposed developments are discussed in the following sections.

6.1.1 Mining development

Broken Hill is Australia's longest-lived mining city. It is also called *The Silver City* owing to its former status as the world's richest source of silver, lead and zinc. BHP-Billiton, an icon of the mining industry, has its roots in Broken Hill. The city's name was derived from a number of hills that appeared to have a break in them. Silver ore was later discovered within these hills and the landforms no longer exist, having long since been mined away. This demonstrates the strong cultural associations with the mining industry and the historical acceptability of making wholesale transformations to the landscape, even to the point of removing the very formations that the city was named after. However this may not be reflective of current attitudes to the landscape.

There are currently eight active mining projects within the study area, some of which may have plans to extend operations. Perilya has established operations south west and south east boundary of the Broken Hill Township. Consolidated Broken Hill operates centrally in Broken Hill near the historic Line of load memorial at the man-made mullock heap. Figure 42 shows a map of the Perilya mine and also the Broken

Hill Mineral Separation Plant which are both located near the project site. Figure 43 shows a view of the Perilya mine from the Silver City Highway.

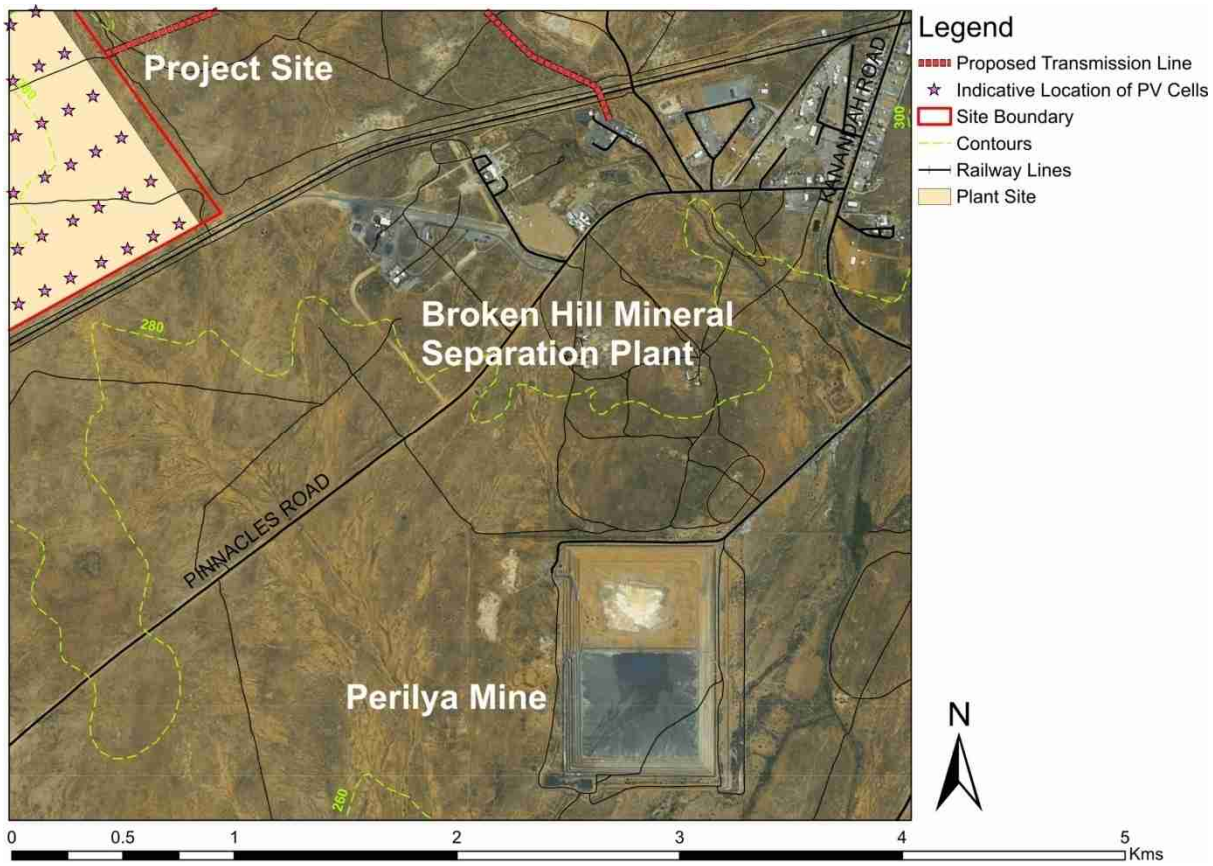

Figure 42 Current mining activity near project site

Figure 43 View of Perilya Mine (on right) from Silver City Highway

6.1.2 Silverton wind farm

Silverton is a small town located approximately 20km northwest of Broken Hill. Silverton Wind Farm is a proposed development which is to be located along a number of ridgelines on the Mundi Mundi Range. The site is approximately 5km north east of Silverton and 25km northwest of Broken Hill. The base of the highest turbine will be at 472m AHD and they will stand at a maximum of 155m from ground level to the tip of blade. A total of 598 turbines, covering an area of approximately 450 square kilometres, have been proposed to be built over 2 stages. Stage 1 of the wind farm, involving 282 turbines, has been project approved. Stage 2, involving 318 turbines, has been concept approved.

Other components of the project would include site access tracks, a control and facilities building, an electrical substation and a 27km long 220kV transmission line between the wind farm and the TransGrid Broken Hill substation. This substation, on the western periphery of Broken Hill, is also the proposed connection point for the transmission line associated with the solar project. The transmission line is likely to comprise steel poles of around 30-35m high.

6.1.3 Broken hill mineral separation plant

The Broken Hill Mineral Separation Plant (BHMSP) is located approximately 0.5km from the south east corner of the solar project site. This facility is associated with the Ginkgo mineral sands mine which is 160km south of Broken Hill. The mineral concentrate produced at the mine is transported to the BHMSP where it is separated and treated to produce minerals for transport via rail.

The most visually apparent component of this facility is the silo and to a slightly lesser extent, the associated buildings and structures. The silo is a prominent feature which can be clearly seen throughout much of the surrounding landscape. There is anecdotal evidence to suggest that there are plans in place to construct 2 more of these silos to assist in expanding the plant operations. This would increase the plant's influence on the landscape character in the vicinity. Other visual impacts associated with this planned expansion may include increases in heavy vehicle movement and dust. Figure 44 shows the view of the plant from Pinnacles Road entrance. Figure 45 shows how this facility is a prominent feature from the surrounding area.

Figure 44 Broken Hill Mineral Separation Plant (from Pinnacles Road entrance).

Figure 45 Broken Hill Mineral Separation Plant (seen from Lunam Street residential area).

6.2 Local and Regional Landscape Values

This section examines various sources of information to determine those characteristics of the local and regional landscape which have a value which is highly regarded by the community. These information sources include the film industry, art and scenic lookouts.

6.2.1 Film industry

Locations in and around Broken Hill, Silverton and the surrounding regions have been utilised as film and commercial locations since 1967. Some of these movies include Dirty Deeds, Mad Max 2 and Priscilla Queen of the Desert. Filming in the region has created tourist attractions for Mad Max enthusiasts and a tribute museum is located in Silverton. There is also a film studio at Broken Hill to support the film industry.

This demonstrates the value of this semi-arid landscape as a movie set with the ability to conjure up associations of alternative realities or to support the objectives of an advertisement. There is a significant commercial and cultural value attached to such an asset which needs to be considered if it were to be modified.

This part of far western NSW has been promoted to the local and international film industry as a unique combination of landscape and infrastructure. The construction of the solar project may present to film makers and photographers an opportunity to utilise this development to add value to their subject matter. It may be suited to a range of film genre or for commercial and educational purposes related to renewable resources or environmental products. Infrastructure can also add an interesting dynamic to a scene when used judiciously by a professional film maker or photographer. Figure 46 shows a scene from the Film

Broken Hill gallery. It shows how the linear infrastructure of road, rail and power combine to create a vanishing point in a mostly featureless landscape.

Figure 46 Landscape and infrastructure (source: www.filmbrokenhill.com).

The production of a film or commercial is a long process which involves, among other things, careful section of suitable filming locations. If the Pinnacles were to be an important subject for filming near the proposed site for instance, it would be possible to choose from many alternative locations which would preclude the solar project from view. Failing that, modern post production editing technology allows for the digital removal of elements within the scene, including the solar project, this being a widespread practice within the film industry.

6.2.2 Art

Both Broken Hill and Silverton currently support an established retail art market and art community, with a number of galleries located in both towns. The region has produced several well known Australian artists including Pro Hart and Jack Absalom. The Pro hart gallery, located in Broken Hill is an important tourist destination and displays his works, many of which feature the local landscape as a primary subject. There are also works by Pro Hart which feature many elements associated with the mining industry, both current and historical examples. Landscape paintings produced by other local artists feature characteristic natural elements of the semi-arid environment such as Eucalyptus trees, dry creek beds, desert dunes, and hills from broad panoramic compositions to smaller scaled studies. Examples of works are described in the following sections.

Located on the Mundi Mundi Plains to the north west of Broken Hill is an example of a work from local artist, Ando. 'Mundi Man', a tribute to the pioneers of the outback, consists of an image of a stockman which has been painted across the landscape. It has been drawn at an immense scale, covering over 4 million square metres. The process was one that took enormous attention to detail and tens of thousands of calculations. This demonstrates an aesthetic whereby immense gestures on the landscape are not considered inappropriate or out of character with the scale of the surroundings. The landscape has essentially been used as a canvas. Figure 47 shows an oblique aerial view of 'Mundi Man' by Ando.

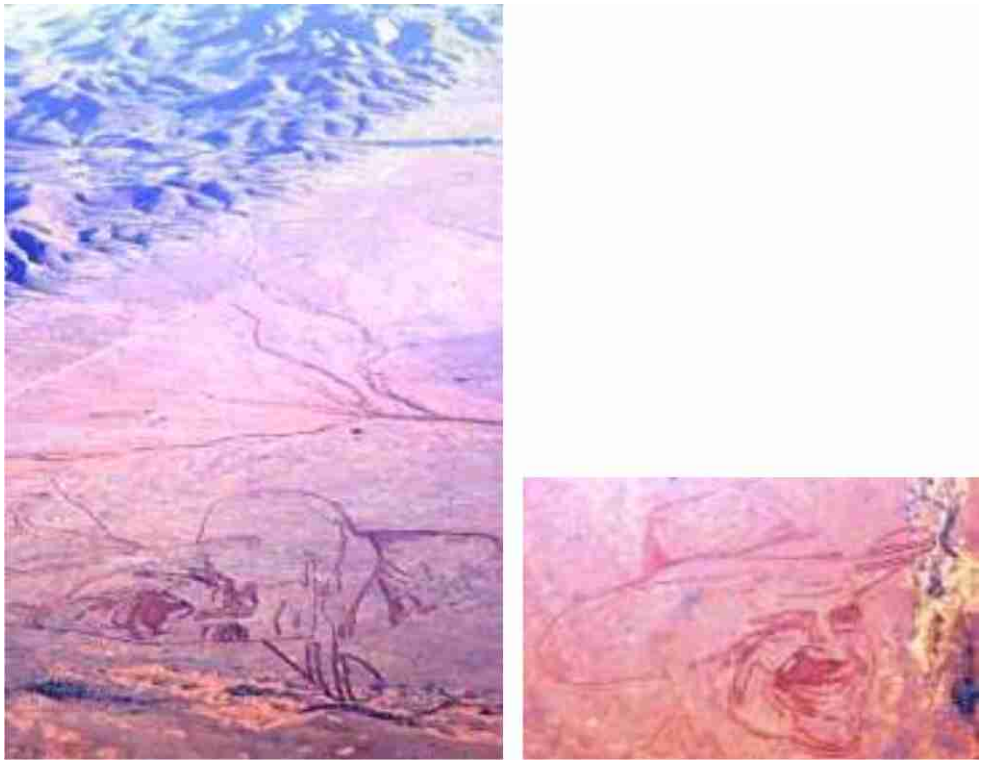

Figure 47 'Mundi Man' by Ando (Source: www.andoart.com).

Figure 48 shows a view within the study area of a gently undulating landscape which is mostly devoid of large trees. Figure 49 shows a painting by Albert Woodroffe of a similar landscape (albeit during a drier period) indicating an appreciation of sparse, arid landscapes.

Figure 50 and Figure 51 is another comparison, this time between mining infrastructure and how this has been used as a subject in a Pro Hart painting, demonstrating the aesthetic and cultural value of mining within Broken Hill.

Figure 48 View from trail to the Sculpture Symposium, north of Broken Hill.

Figure 49 “Late summer colour” Albert Woodroffe (source: www.horizongalleries.com.au).

Figure 50 View of mining headframe on Bonanza Street.

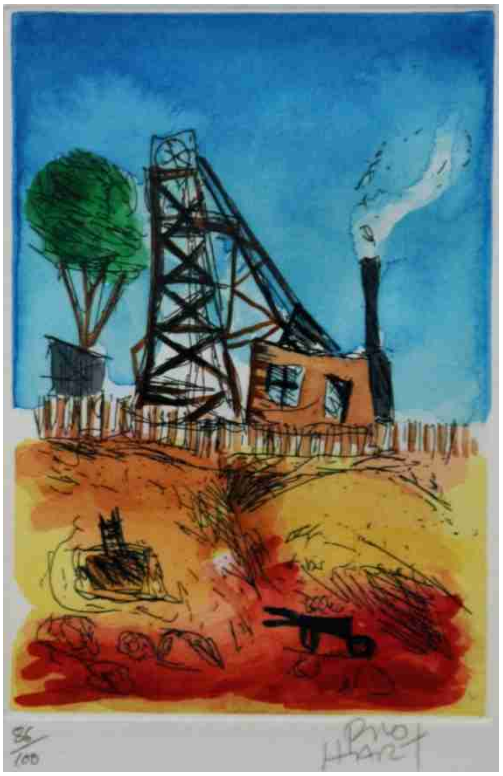

Figure 51 Pro Hart painting of mining headframe.

The value of art lies in its ability to record and convey the central underlying themes of human concern and often ties well with a specific locality. By studying various artworks, we can gain an appreciation for the type of values which are attached to various elements of the local landscape. The artwork produced around Broken Hill suggests that whilst the natural features of the outback landscape is highly valued, there is also an appreciation of industrial activity and its associated cultural and historical value. These artificial elements exert a strong visual influence over the character of the surrounding landscape. The vast scale of the sparse, arid environment is also able to accommodate major modifications without seeming to be out of context.

6.2.3 Scenic lookouts

Scenic lookouts are typically placed at vantage points which offer broad views over the landscape and prominent topographical elements or features of interest for educational value. By analysing views from scenic lookouts, we can gain an understanding of the landscapes and elements which have values associated with them.

Broken Hill is marketed as the 'accessible outback' and acts as a gateway to numerous outback experiences nearby. Mundi Mundi lookout is located approximately 25km northwest of Broken Hill. From this lookout, one can gain 180 degree views over a flat, barren expansive landscape with very little vegetation cover or topographical relief. Far from being devoid of any scenic value, this lookout demonstrates the value of

‘absence’ and the landscape is still considered as a delicate resource not an empty wasteland. It is this ‘emptiness’ which people associate with the outback and forms a valuable part of that experience. This lookout is also one of the principle vantage points in the area for sunset viewing. The sunsets from this location can at times, provide an intense and dramatic landscape feature. Figure 52 shows the view from Mundi Mundi lookout. This view was used as a backdrop for film production.

Figure 52 Mundi Mundi lookout (source: www.filmbrokenhill.com).

There are a number of designated scenic lookouts, some natural and some manmade, within the Broken Hill Township. The most notable of these include the ‘Line of Lode’ lookout, which is located as the top of a mullock heap, composed of spoil from mining activity. This lookout is located within the centre of the town and offers views over the northern and western part of Broken Hill and into the landscape beyond. There are also many mining artifacts as well as the Miner's Memorial which commemorates miners who lost their lives. Another well promoted lookout is JP Keenan Lookout, located in the northern part of the town, which offers views east over the town and south toward Line of Lode Mine. Block 10 lookout is another signposted example which looks out over historical mining relics and spoils from mining operations.

These lookouts generally focus on the town and the mining activity which is inextricably linked with the townscape. Typically, there is interpretative signage displaying text and images describing how mining has influenced the town’s development. Rather than being treated as a blight on the landscape, the urban fabric of Broken Hill embraces mining as an important part of its history. Figure 53 shows a view from JP Keenan lookout south east toward Line of Lode mine site. The Line of Lode Lookout can also be seen from this location. This demonstrates the immense scale and proximity of the mine, which divides the northern

from southern part of Broken Hill. Infrastructure and manmade modifications are a ubiquitous and celebrated part of this landscape. Figure 54 shows the location of these lookouts. The Sculpture Symposium is discussed later in Section 5.2.

Figure 53 View from JP Keenan Lookout south toward Line of Lode mine site.

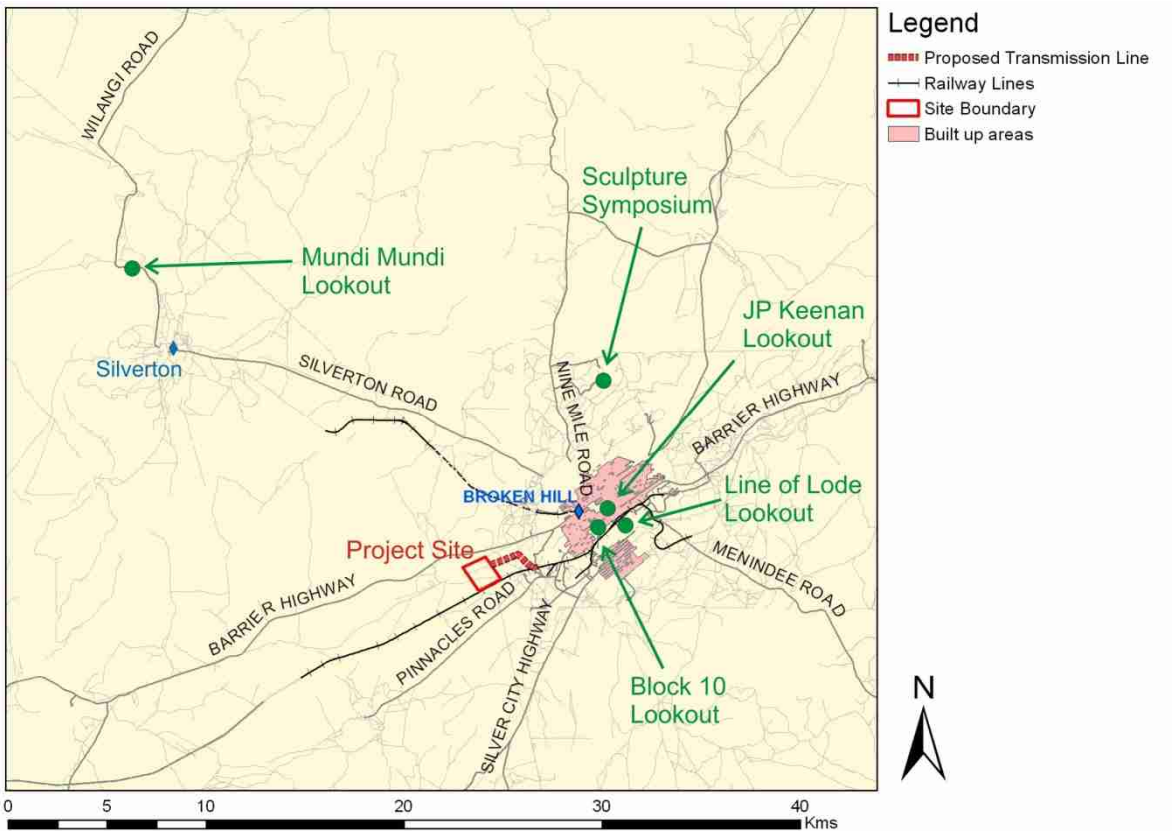

Figure 54 Location of scenic lookouts.

6.3 Summary of Landscape Context

This chapter has outlined the characteristics and values of the landscape within the study area and region to determine the degree of compatibility between the proposed development and its context. These values have been ascertained by studying the landscape itself and various cultural expressions which utilise the landscape as a source of inspiration. Future developments have also been taken into consideration as these will influence the changing baseline conditions. The main outcomes of this section can be summarised as follows:

- The scale of the landscape surrounding Broken Hill is vast and can accommodate many large scale developments (or works of art) without them necessarily appearing to be out of context.
- The landscape is undergoing a process of continuous long term change. These changes are geared along the path of industrial development with a new focus on renewable energy.
- Manmade modifications to the landscape, particularly associated with the mining industry are embraced and form an important part of the historical context of the region.
- The arid and relatively featureless outback landscape is a valuable commodity and offers an important experience for visitors, i.e. 'nothingness'.
- A great variety of visual experiences is usually a saleable marketing point for tourism.

7. Reflectivity

The purpose of a solar panel is to absorb as much light as possible for conversion to electricity. Any light reflected from a solar panel would thereby reduce its efficiency. The *First Solar- FS series* solar modules planned for use in this project are expected to have minimal reflective qualities compared with normal glass. These modules appear darker than traditional crystalline silicon modules in nearly all conditions, indicating less light reflection. Studies in Germany and the USA based on existing solar projects indicate that solar panels typically emit less reflection (i.e. glare) than many other materials and surfaces common in the landscape. The solar panels therefore would not noticeably alter the site's current amount of reflected and indirect sunlight in most conditions. The specific potential glare effects on air travel, roads and railways are discussed as follows.

7.1 Air Travel

There have been a number of precedents, mainly in the USA, whereby solar projects have been installed directly adjacent to airports. There have been no reported cases of these installations causing glare issues for pilots, even during the critical landing and taking off stages. Indeed, large glass panels associated with terminal buildings have a greater propensity to emit glare. Pilots have however been reported to use the solar projects for orientation purposes. Figure 55 shows the solar project adjacent to Denver International Airport.

Figure 55 Denver International Airport Solar Project.

Anecdotal evidence obtained from a pilot of Wettenhall Air Services (operating out of Broken Hill Airport) has indicated that glare is rarely an issue whilst flying. Glare is usually only a problem if the object in

question is in direct line of sight of the runway. Figure 18 shows that this is not the case with the proposed solar project. Heading into the sunrise or sunset represents the worst conditions for landing and taking off, with direct light being more of an issue than reflected light, which is also common at this time. Pilots are highly skilled professionals who are able to deal with a range of adverse climactic and lighting conditions. They will usually choose an option which best avoids risk to the landing or taking off procedure.

7.2 Roads

The Barrier Highway is the road which is most likely to experience glare impacts due to its close proximity to the site. Figure 56 shows the Barrier Highway.

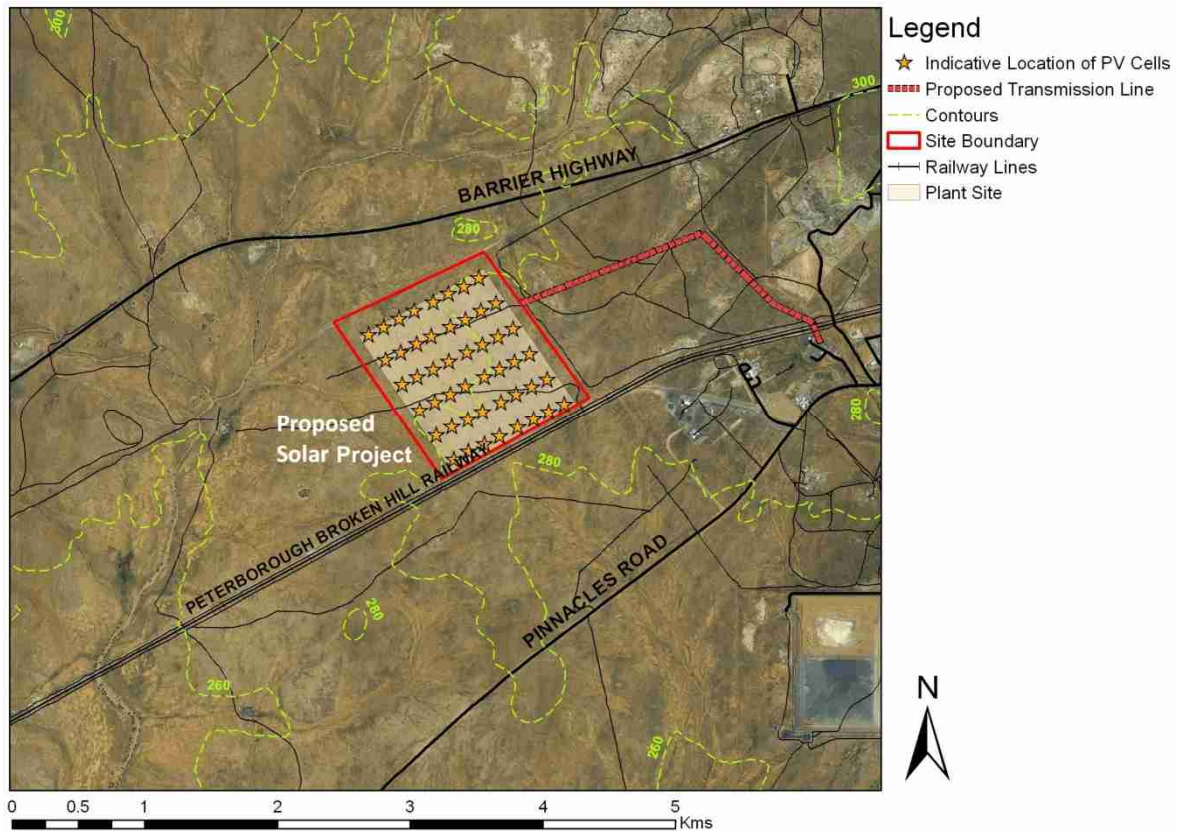

Figure 56 Barrier Highway.

To describe how the Barrier Highway may be impacted, it will be necessary to briefly explain some geometric relationships. The amount of light reflected from the solar panel surface has an exponential relationship with the angle of incidence of sunlight. The angle of incidence can be described as the angle that a ray of light makes with the normal to a surface at the point of meeting. The normal is an imaginary line extending perpendicular to the surface. The angle of incidence is indicated by θ in Figure 57.

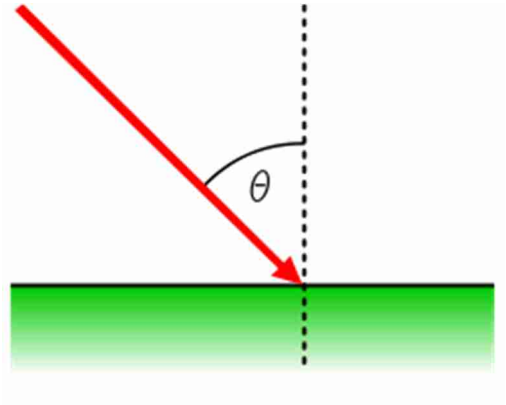

Figure 57 Angle of incidence = **θ**.

As the angle (θ) increases, so does the amount of light reflected. This can be likened to light reflecting off a body of water when the sun is low on the horizon. Further information on this phenomenon can be found in *Appendix B: Reflectivity Information*. It is for this reason that the Barrier Highway may be impacted by glare under the following conditions:

1. Motorists heading west toward the site when the sun is low on the western horizon (late afternoon), particularly in summer months.

2. Motorists heading east toward the site when the sun is low on the eastern horizon (early morning), particularly in summer months.

This phenomenon would be based on a very complex interaction between time and the sun's position in the sky, elevation and slope of the road, time of year, climactic conditions and final configuration of the solar panels. It is therefore beyond the scope of this study to predict with any real accuracy those locations which would be potentially impacted without further specialist studies. It can be noted however that any glare experienced would be temporary and would shortly pass as one drives along. Also, not all panels will reflect light toward the same vehicle as they are in a fixed unidirectional orientation. In addition, the amount of reflected light would remain below 10% of the suns strength for angles of incidence below 50°. The sun would have to be quite low for a significant amount of glare to be emitted. The low sun in itself would be a problem let alone the glare issue and most responsible drivers would normally pull over or take extra precaution under these conditions. Throughout the rest of the day, glare would not be an issue as a minimum of light is reflected upward as shown in Figure 58.

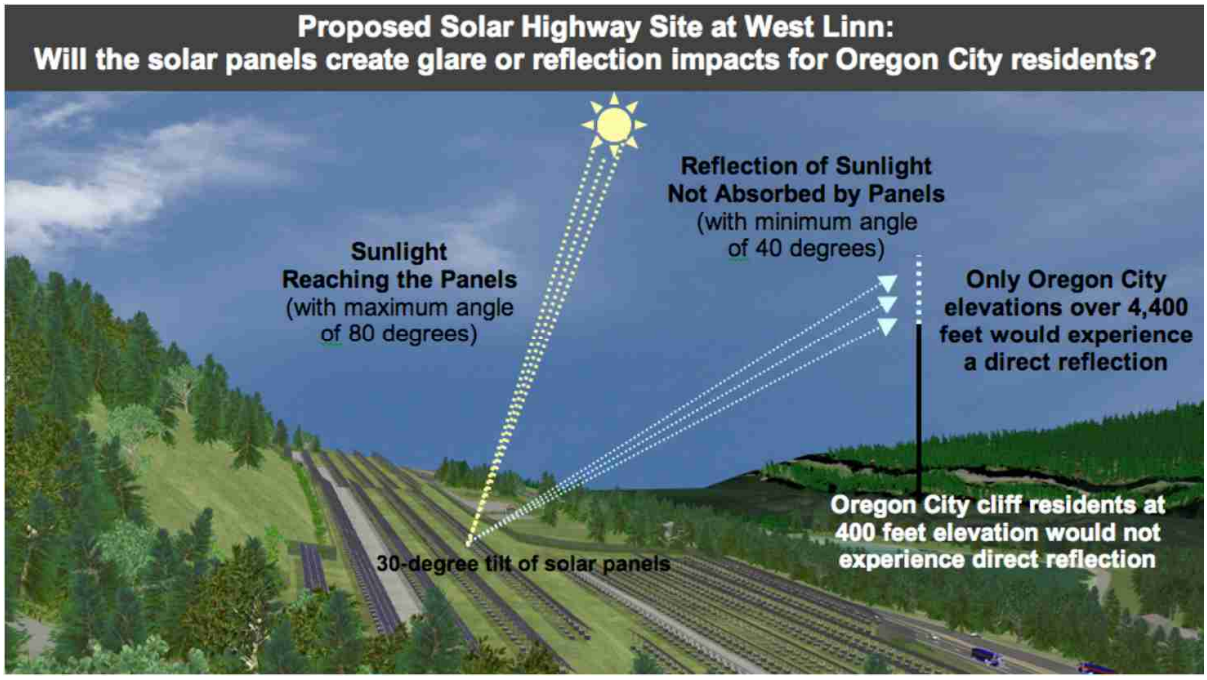

Figure 58 Solar glare studies for Oregon USA (source: www.oregon.gov).

7.3 Railways

The Peterborough-Broken Hill Railway is the closest railway line and runs to the south of the site. As the solar panels face north, glare impacts are expected to be minimal. The only exception to this would be if a train was heading south west toward the site when the sun is low on the western horizon. The only people to experience this impact would be the driver and crew. As trains are on a fixed path, there is no real danger of losing control of the vehicle. Reflection from features such as salt lakes and sandy plains, common features in this region, are likely to be far higher and train drivers would be used to dealing with such phenomenon.

8. Mitigation Measures

Mitigation of visual impact typically involves the planting of vegetation to visually integrate the proposed development into its context or to filter it from view. This can be achieved by either planting directly adjacent to the development or planting along roadsides and other visually impacted locations with a clear line of sight to the project. Occasionally, there may be a conflict whereby the planting of vegetation not only mitigates impact but also screens other landscape features from view which have high visual amenity. Mitigation options should be carefully considered to ensure that this is avoided as best as possible. Other mitigation options include alterations to the design of the structures to assist with visual integration into the surrounding landscape.

The only area assessed as having a high impact for either the transmission line or solar project is *Viewpoint 4 – Barrier Highway #4* located approximately 770m to the north east of the solar project site adjacent to the Barrier Highway. This location is on a relatively elevated position with a clear view to The Pinnacles. The foreground has relatively few manmade elements and the presence of the solar project would result in a substantial change to the visual characteristics of the landscape to the west.

The planting of locally indigenous, shrubby vegetation along the north eastern and part of the north western boundary would reduce this impact by a considerable measure whilst preserving the visual amenity of The Pinnacles. Care must be taken in the selection of suitable species that will not grow so tall as to also block The Pinnacles from view. These measures would also reduce the impact from viewpoints 17, 18 and 19 which are located along Silverton road and Magazine Way. These were assessed as medium for the solar project.

Mitigation planting along the other boundaries of the solar project is not required as visual impact was not assessed as high in other areas. Mitigation of the transmission line is also not required as the transmission poles would visually integrate with the numerous other transmission lines in the near vicinity. Figure 59 shows the lines of sight between the viewpoints mentioned above and The Pinnacles. These lines of sight pass within close proximity and over the solar project site. Figure 60 shows an indicative plan of the proposed mitigation planting.

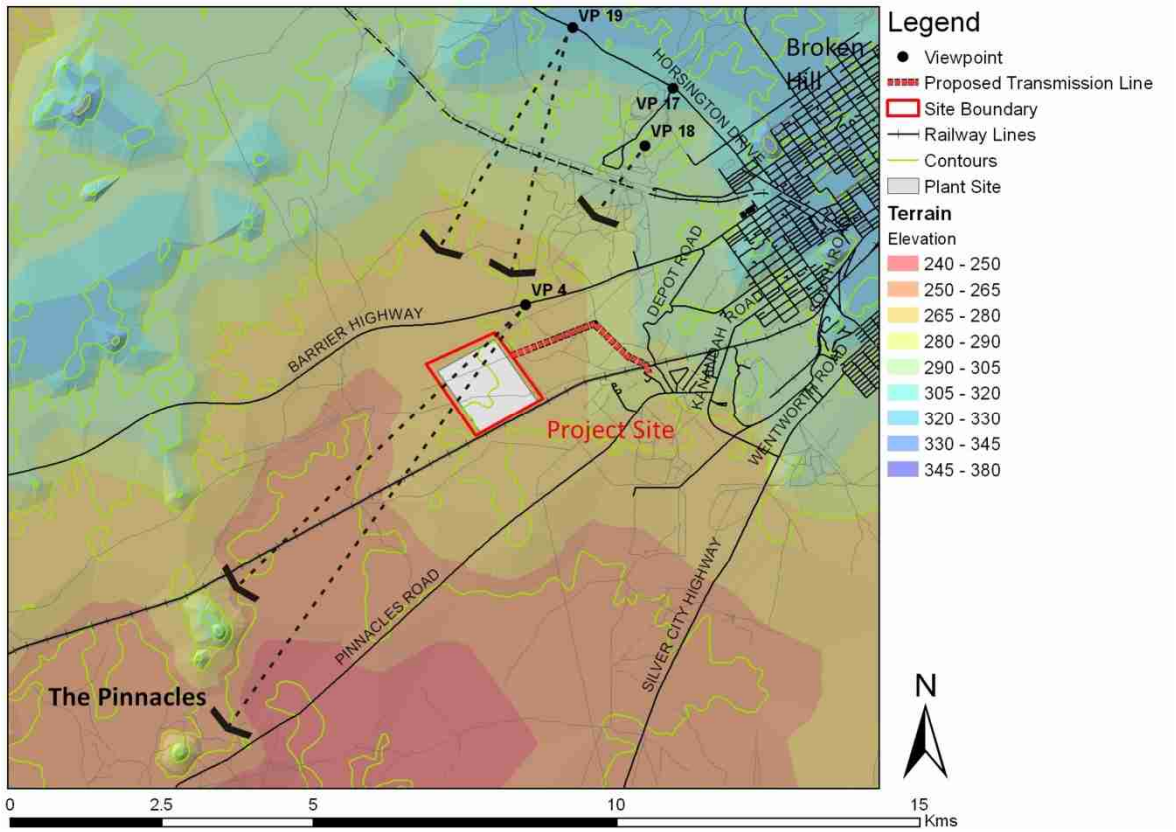

Figure 59 Spatial relationship between viewpoints, solar project site and The Pinnacles.

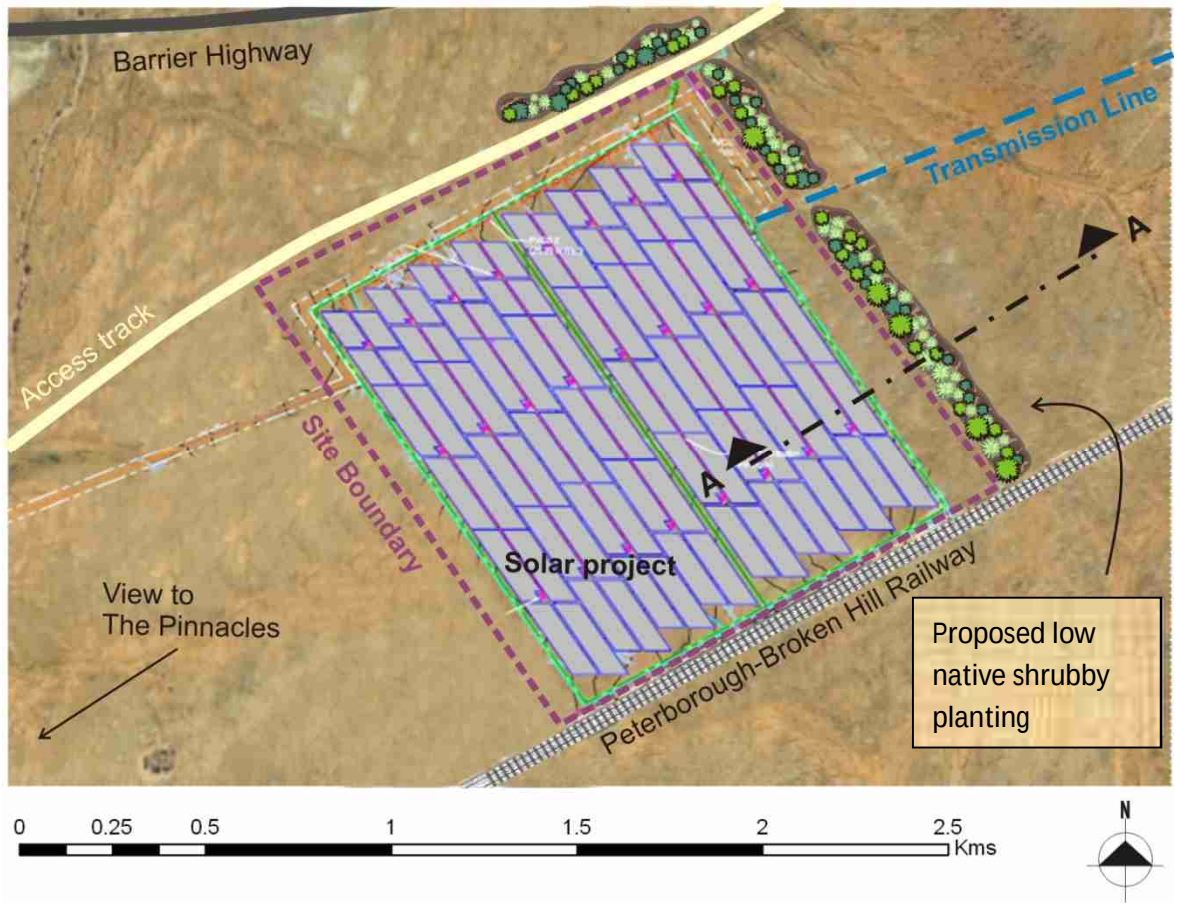

Figure 60 Indicative landscape mitigation plan.

Other mitigation measures should be utilised in addition those described above. These include the following:

- Access tracks to be constructed of locally sourced gravel and a colour which most closely matches existing site surface.
- Vegetation removal avoided as best as possible during construction. Any native vegetation near the outside edge of the solar project site boundary will be cordoned off to ensure it is not disturbed during construction.
- Vehicles to remain on designated paths during construction to avoid degradation to the landscape.
- Construction equipment and infrastructure will be demobilised from site as soon as practicable and all unnecessary project flagging and signage will be removed and disposed of at the completion of construction.

- Colour of any ancillary electrical equipment associated with the solar project is to be of earthy tones (pale green, pale brown etc) or as appropriate to best match the surrounding context.
- Underground cabling to be used as far as practical.
- Glare impacts are considered unlikely. If required, glare impacts at specific locations along Barrier Highway could be ameliorated through roadside planting.

9. Conclusion and Recommendations

This Landscape and Visual Impact Assessment has determined that the solar project would generally have a low or negligible visual impact. The only area where it would have a high impact is along the Barrier Highway close to the northeast corner of the site, viewing southwest toward The Pinnacles (Viewpoint 4). A medium impact has been assigned to locations along Silverton Road and Magazine Way which offer similar views of The Pinnacles (Viewpoints 17, 18 and 19). The transmission line would have a very low visual impact especially for locations beyond 1km away. In many cases it will visually integrate with many other transmission towers which exist in the area, many of which are much larger.

The visual impact of the solar project from Barrier highway may be mitigated through planting of low shrubby vegetation. This will inhibit views of the solar project whilst maintaining views toward The Pinnacles, which is an important local visual resource.

Views east toward the site from Barrier Highway will take in the solar project against the backdrop of numerous industrial and mining developments. It is for this reason that mitigation is not required from these locations. The presence of the solar project may in fact offer a positive contribution to the viewing experience and act as a gateway element when approaching Broken Hill. This is especially relevant considering the vast, flat and featureless landscape that would be traversed when approaching from Adelaide.

There could possibly be glare impacts to some sections of Barrier Highway during the early morning and late afternoon, although these potential impacts are considered unlikely. If required, any impacts would be minor and could be mitigated with roadside planting.

The landscape surrounding Broken Hill is diverse. It already contains and can accommodate many other large scale developments. The landscape is undergoing a process of continuous change driven by ongoing industrial development. Whilst the protection of natural landscape resources is important, the addition of the solar project could add to the diversity of visual experiences in the region. Interpretive signage with viewing areas could also be used to capitalise on the educational value of the installation. Figure 61 shows a sheltered information board located adjacent to the Windorah Solar project in Queensland, which was built in October 2009.

Figure 61 Interpretive sign: Windorah Solar Project Queensland (Source: www.penbroke-graphics.com).

10. References

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- www.railmaps.com.au
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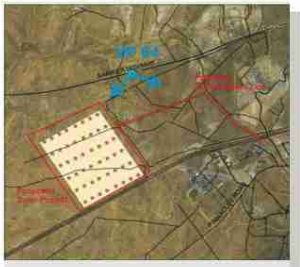
- www.firstsolar.com
- www.andoart.com

Appendix A: Photomontages

Existing view looking south from Barrier Highway (north east of site).

Photomontage of proposed solar power project and transmission line.



SITE DATA

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Projection:	GDA 1994 MGA Zone 54
Camera:	Nikon D3 (Digital SLR)
Lens Size:	90mm
Photo Direction:	South
No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

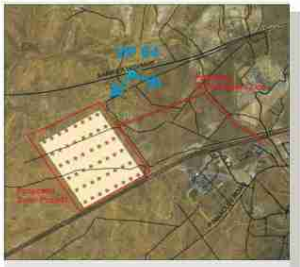
Drawing No. 5-9

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south from Barrier Highway (north east of site).

Photomontage of proposed solar power project and transmission line.



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No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

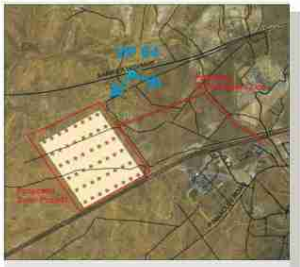
Viewpoint 4b

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south east from Barrier Highway (north east of site).

Photomontage of proposed solar power project and transmission line.



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Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

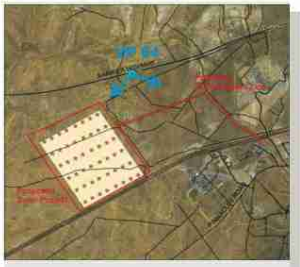
Drawing No. 5-10

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south east from Barrier Highway (north east of site).

Photomontage of proposed solar power project and transmission line.



SITE DATA

Location:	Barrier Highway
GPS:	E 537597 N 6462202
Projection:	GDA 1994 MGA Zone 54
Camera:	Nikon D3 (Digital SLR)
Lens Size:	90mm
Photo Direction:	South East
No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

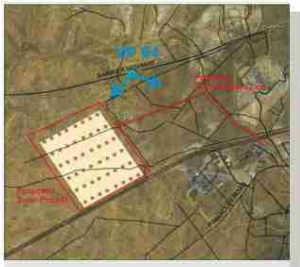
Viewpoint 4c

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south west from Barrier Highway (north east of site).

Photomontage of proposed solar power project and transmission line.



SITE DATA

Location:	Barrier Highway
GPS:	E 537597 N 6462202
Projection:	GDA 1994 MGA Zone 54
Camera:	Nikon D3 (Digital SLR)
Lens Size:	90mm
Photo Direction:	South West
No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

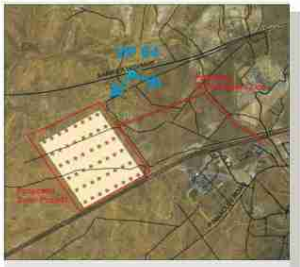
Drawing No. 5-8

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south west from Barrier Highway (north east of site).

Photomontage of proposed solar power project and transmission line.



SITE DATA

Location:	Barrier Highway
GPS:	E 537597 N 6462202
Projection:	GDA 1994 MGA Zone 54
Camera:	Nikon D3 (Digital SLR)
Lens Size:	90mm
Photo Direction:	South West
No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

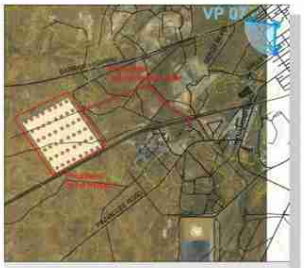
Viewpoint 4a

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south west from Lunam Street Residential Area (north east of site).

Photomontage of proposed solar power project and transmission line.



SITE DATA

Location:	Lunam Street
GPS:	E 541401 N 6463137
Projection:	GDA 1994 MGA Zone 54
Camera:	Nikon D3 (Digital SLR)
Lens Size:	90mm
Photo Direction:	South West
No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

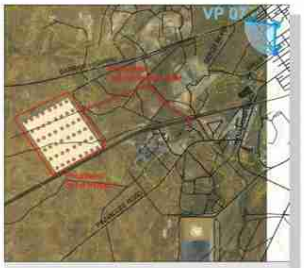
Drawing No. 5-11

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Existing view looking south west from Lunam Street Residential Area (north east of site).

Photomontage of proposed solar power project and transmission line.



SITE DATA

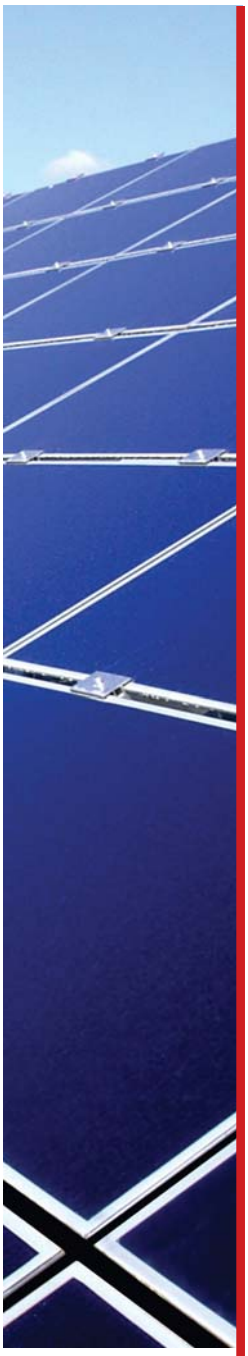
Location:	Lunam Street
GPS:	E 541401 N 6463137
Projection:	GDA 1994 MGA Zone 54
Camera:	Nikon D3 (Digital SLR)
Lens Size:	90mm
Photo Direction:	South West
No of Photos:	4
Overlap:	1/3
Date of Photography:	16th March 2011
Date of Photomontage:	13th May 2011
Project Reference:	HA01345

Viewpoint 7

AGL Energy - Solar Power Project and Transmission Line Photomontages

SINCLAIR KNIGHT MERZ
SKM

Appendix B: Reflectivity Information



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.

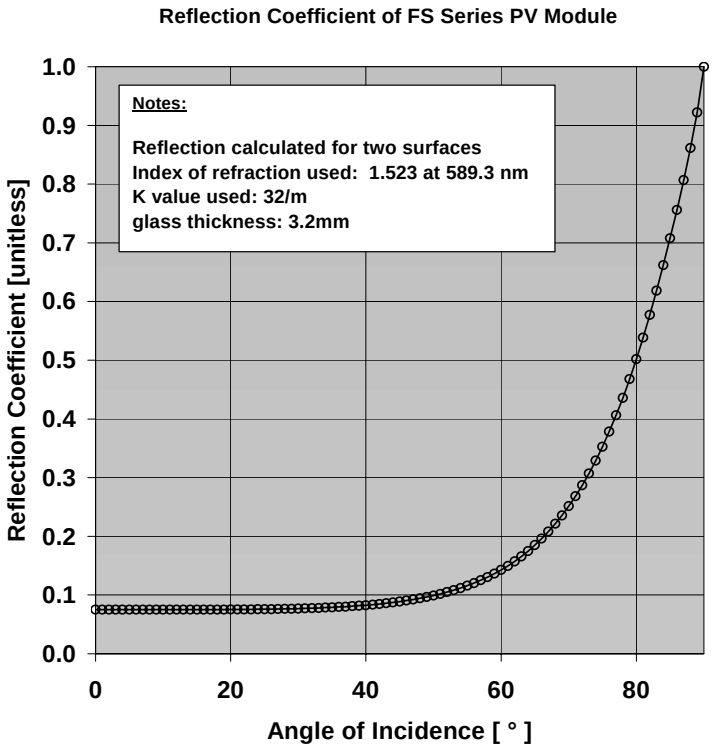


Figure 1. Reflection versus angle of incidence. Behavior is dominated by difference in the indices of refraction at the air/glass interfaces.

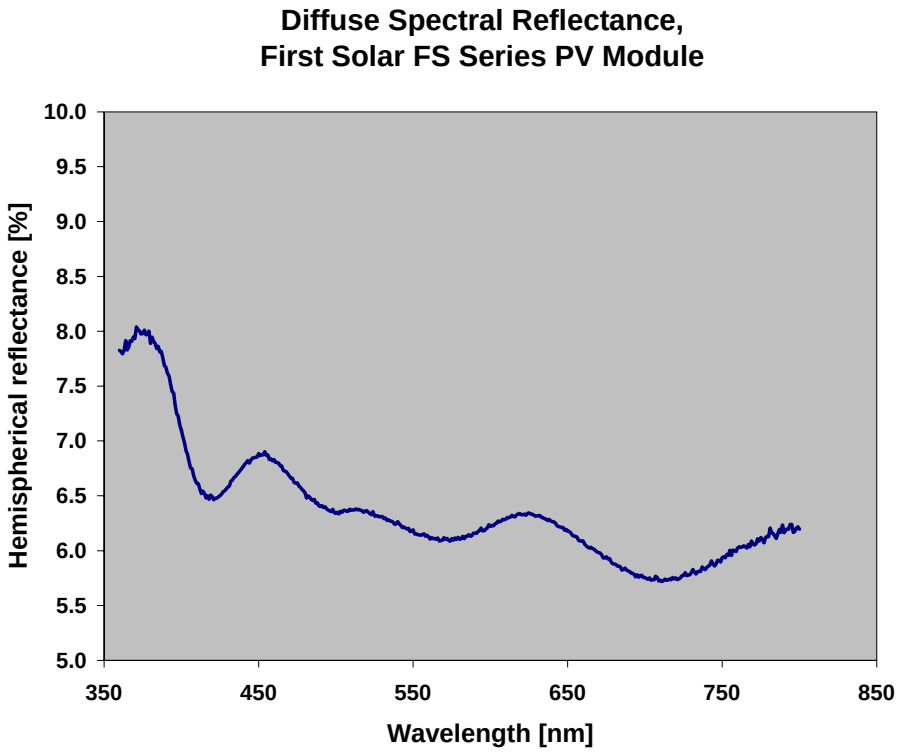


Figure 2. Diffuse spectral reflectance, as measured with a spectrophotometer with an integrating sphere attachment.

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.