

AGL

Broken Hill Solar Plant

ENVIRONMENTAL ASSESSMENT

Volume 2 – Environmental Assessment:
Chapter 7 to Chapter 15

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7. Flora and Fauna

This chapter summarises the key findings of the Flora and Fauna Impact Assessment undertaken for the project.

The *Flora and Fauna Impact Assessment* report is attached as **Appendix E**.

The Director-General's Requirements

The Environmental Assessment must:

- *Include an assessment of the impacts of all project components on flora and fauna (both terrestrial and aquatic, as relevant) and their habitat consistent with the Draft Guidelines for Threatened Species Assessment (DEC 2005) and taking into account the Western Catchment Action Plan (Western CMA 2007) and the Lower Murray-Darling Catchment Action Plan (Lower Murray-Darling CMA 2008) including details on the existing site conditions and likelihood of disturbance (including quantifying the worst case extent of impact on the basis of vegetation type and total native vegetation disturbed).*
- *Specifically consider impacts on threatened species and communities listed under both State and Commonwealth legislation that have been recorded on the site and surrounding land, impacts on riparian and or instream habitat in the case of disturbance of waterways, and on biodiversity corridors.*
- *Include details of how flora and fauna impacts would be managed during construction and operation including adaptive management and maintenance protocols (including the mitigation and/or management of weeds).*
- *Include measures to avoid, mitigate or offset impacts consistent with "improve or maintain" principles. Sufficient details must be provided to demonstrate the availability of viable and achievable options to offset the impacts of the project.*

The following stakeholder comments have been addressed in the preparation of this chapter:

Issues raised	Chapter location
Office of Environment and Heritage (formerly Department of Environment, Climate Change and Water)	
An assessment of the impacts the project may have on threatened species and their habitat and the action that will be taken to avoid or mitigate impacts or compensate unavoidable impacts.	Section 7.3, 7.4
Department of Primary Industries (formerly Land and Property Management Authority)	
Weed and feral animal control, including noxious weeds.	Section 7.3.4
Impacts on threatened flora and fauna species, populations and ecological communities, and habitats, including full outline of survey methods, survey results, and methods for minimising impacts.	Section 7.1, 7.3
Ecological effects, including impacts on corridors, connectivity, and vegetation diversity.	Section 7.3.1

Issues raised	Chapter location
Rehabilitation/ regeneration of construction sites and disused access tracks, and monitoring programs (timing and method of rehabilitation, species to be reintroduced).	Section 7.4

7.1. Assessment Methodology

7.1.1. Background review

A review of relevant background reports and government databases pertaining to the biodiversity of the bioregion and the locality surrounding the study area was undertaken. The literature and data reviewed included the following:

- Atlas of NSW Wildlife (NSW OEH) with a focus on threatened species known and predicted from the Western Barrier Range Catchment Management Authority subregion.
- Western Catchment Action Plan (Western CMA, 2007) and the Lower Murray-Darling Catchment Action Plan (Lower Murray Darling CMA, 2008).
- The NSW Vegetation Classification and Assessment database (Benson 2006 & 2008) developed by the Royal Botanic Gardens and Domain Trust. This provides a list and detailed descriptions for plant communities in western and central western NSW.
- Records published in scientific journals, specialist ecological reports and general flora and fauna distribution texts, including Reid and Fleming (1992) and Sadlier and Pressey (1994).
- Threatened Species, Population and Ecological Communities of NSW (http://www.threatenedspecies.environment.nsw.gov.au/index.aspx).
- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (http://www.environment.gov.au/erin/ert/epbc/index.html).

7.1.2. Field survey

A field investigation was conducted to investigate the flora and fauna species and ecological values on the site with the objective of assembling quantitative and qualitative data on the flora and fauna diversity and the distribution of vegetation and habitat associated with the study area. The survey concentrated on the entire proposed development area and any adjacent habitats potentially impacted by the project, including the solar PV plant infrastructure and the 22 kV transmission line.

Terrestrial field surveys were undertaken between the 7th and 10th of December 2010. The extent of survey effort and the survey techniques employed were consistent with the *Draft Guidelines for Threatened Species Assessment* under s75F of the EP&A Act (DEC and DPI, 2005) and *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC, 2004).

Aerial photographs, existing broad-scale vegetation mapping, landscape data and topographic maps (1: 25,000) were used to stratify vegetation and habitats into individual units and identify appropriate sampling sites according to the extent of each unit.

Surveys were conducted for both terrestrial flora and terrestrial fauna. The flora surveys involved a combination of general traverses or transects, plot-based quadrat assessments and targeted searches for threatened flora species. The fauna surveys included detailed habitat assessment, dedicated surveys for diurnal birds, mammals, amphibians and reptiles, and the recording of signs of significant fauna. Surveys for aquatic flora and fauna were not required given the absence of aquatic systems and habitat within the project site and immediate surrounds. Further detail on the methodology used for the flora and fauna assessment is provided in **Appendix E**.

7.2. Existing Environment

The study area lies within the Broken Hill Complex Bioregion (Thackway and Cresswell, 1995), which is characterised by chenopod shrublands comprising saltbush, bluebush and Mulga (*Acacia aneura*) communities (Benson, 1999). The project site comprises rural land on the western edge of the Broken Hill township, with flat to slightly undulating topography and shallow stony soils. The majority of the site is vegetated, with the exception of a residential building and farm sheds, vehicle tracks and an existing power line easement. A history of selective clearing of Mulga is evident, mainly for tracks, fence posts and timber. There is also evidence of light stock grazing, predominantly from horses, and damming of the central drainage line. There are no permanent creeks or waterways on the site and the aquatic environment is restricted to the ephemeral drainage line running centrally through the property and a small dam at the northern boundary.

7.2.1. Flora

Vegetation communities

The majority of the study area supports remnant vegetation in a relatively natural condition, although some areas exhibit evidence of disturbance in the form of selective vegetation clearing, track formation and minor weed invasion as a result of past land use activities. A total of 129 plant species from 32 families were identified from the survey across the project site. This total included two fern species, 110 species of dicotyledons and 17 species of monocotyledons. Of the total number of species recorded, 19 (15 per cent) were introduced species.

Up to 80 per cent of the site is dominated by chenopod shrublands, with some small areas also supporting Wattle species (*Acacia sp*.) and the remainder comprising cleared tracks or building areas. The vegetation is generally in a high quality condition, supporting a diversity of native species with a low to moderate abundance of exotic plant species.

There are six vegetation map units within the study area (refer to **Figure 7-1**), including four main vegetation communities and two modified areas. Vegetation communities have been classed

according to biometric vegetation types and the NSW Vegetation Classification and Assessment (Benson, 2006), comprising:

- Map Unit 1: Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zone.
- Map Unit 2: Prickly Wattle open shrubland of drainage line on stony rises and plains of the arid climate zone.
- Map Unit 3: Narrow-leaved Hopbush-Scrub Turpentine – Senna shrubland of semi-arid and arid sandplains and dunes.
- Map Unit 4: Mulga Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions.
- Map Unit 5: Disturbed Chenopod Low Open Shrubland.
- Map Unit 6: Cleared Residential.

A full description of the six map units is provided in **Appendix E.**

Threatened ecological communities

No threatened ecological communities listed under TSC Act or EPBC Act were identified on the site or in the immediate surrounds. Only one threatened ecological community was identified as potentially occurring in the study area, namely *Acacia loderi* Shrublands, which is listed as endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Several other species of Wattle (*Acacia*) were recorded in the study area, however targeted searches did not identify the presence of *Acacia loderi* on the site. The field survey confirmed that the *Acacia loderi* Shrublands threatened ecological community does not occur in the study area and would not be affected by the project.

Vegetation condition

The vegetation condition was determined through comparisons of vegetation data collected in the study area. The results of this assessment are shown in **Appendix E** and indicate that much of the vegetation on site is in a near natural state, with some reduction in condition associated with clearing for tracks and trials, erosion and natural plant dieback.

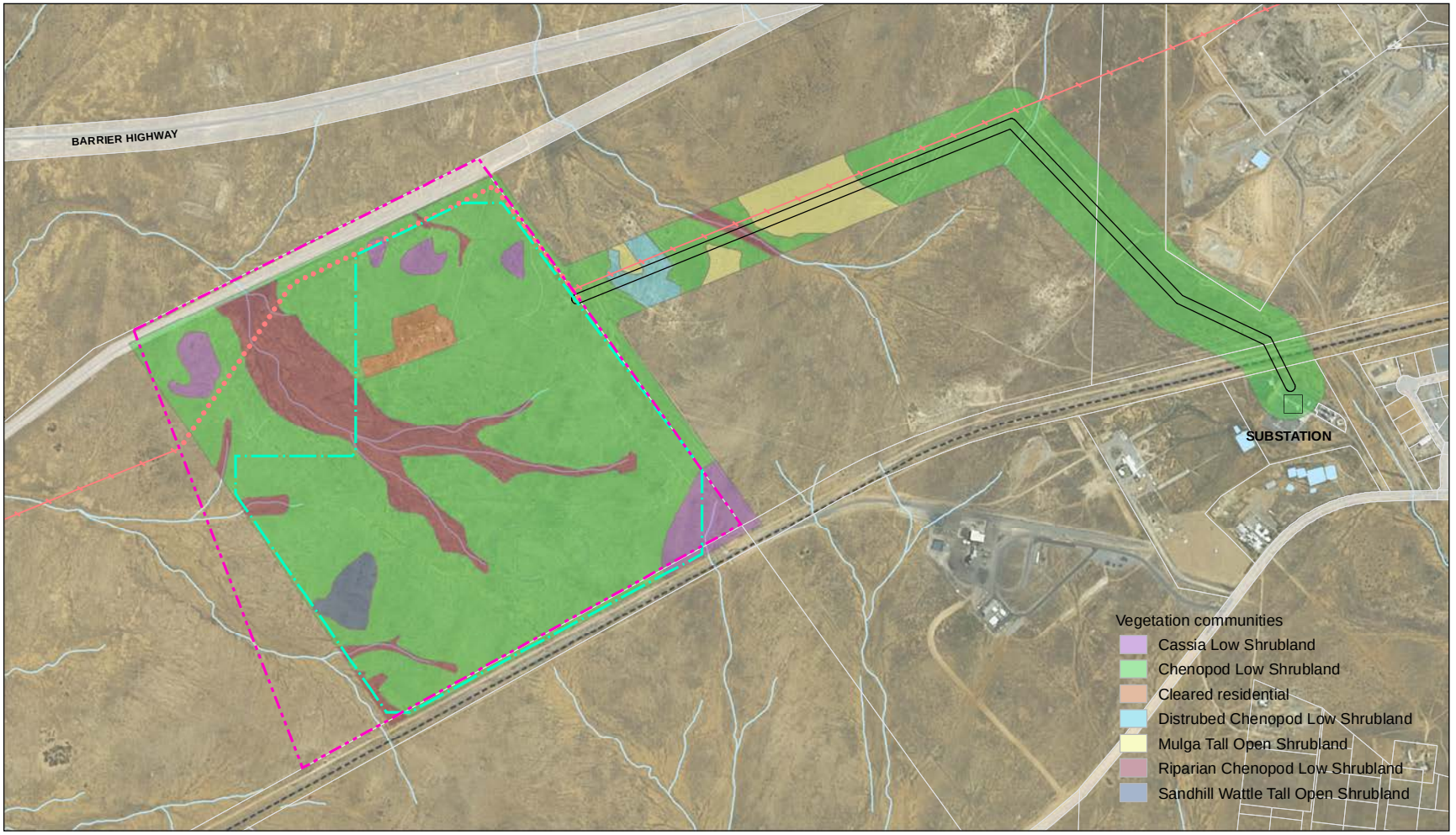

Figure 7-1 Vegetation communities in the study area

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Spatial Team - Prepared by : JC
Checked by : JL

Threatened flora

Twelve threatened flora species have been previously identified or have been identified as potentially occurring within 25 kilometres of the study area, including species listed as endangered or vulnerable under the TSC Act and the EPBC Act. The locations of previously recorded threatened flora species are shown in **Figure 7-2**.

Two threatened flora species, the Koonamore Daisy (*Erodiophyllum elderi*) and Creeping Darling Pea (*Swainsona viridis*) were assessed as having a high likelihood of occurring in the study area. Both species were targeted in comprehensive surveys across the entire project footprint, including the solar PV plant site and transmission line easement. No state or nationally threatened flora species (including the Koonamore Daisy and the Creeping Darling Pea) were recorded in the targeted searches. Further information on these species is provided in **Table 7-1**.

The Koonamore Daisy and Creeping Darling Pea flower during spring and early summer, coinciding with the timing of the targeted surveys (7-10 December 2010). In addition, these surveys were conducted following high rainfall in November 2010 (65.2 mm), which equated to more than three times the average rainfall for November in Broken Hill. Additionally there was a further 50 mm of rainfall in December around the time of the survey. This suggests that site conditions at the time of the field surveys would have been optimum for detection of both threatened species, thus providing a high level of certainty that these species are not present on the project site.

The Purple Wood Wattle (*Acacia carneorum*) was identified as having a moderate likelihood of occurring in the study area. This species was not identified during targeted field surveys and is considered to have a low likelihood of occurring. As such a test of significance under the TSC Act was not required.

Table 7-1 Threatened flora species with suitable habitat types present in the study area

Threatened flora	Status*	Potential to occur in the study area
Erodiophyllum elderi Koonamore Daisy	TSC Act: Endangered RoTAP: -	There is a record of this species from 1921 approximately 61 km south-west of the study area. The flat open areas of sandy calcareous soils in the project area provide potentially suitable habitat for this species. Associated vegetation includes *Acacia aneura* shrublands with *A. burkittii* and *Dissocarpus paradoxus*, all of which are present in the study area, in particular within the Mulga Tall Open Shrubland and Sandhill Wattle Tall Open Shrubland. Koonamore Daisy flowers during spring and early summer, so the survey period was optimum (7-10 December 2010). Given the above average rainfall during spring/summer 2010, flowering plants and live material (including seed heads) of this species would have been visible and readily identifiable if present.

Threatened flora	Status*	Potential to occur in the study area
Swainsona viridis Creeping Darling Pea	TSC Act: Endangered RoTAP: 3K	Uncommon in the Broken Hill and Silverton districts in the far north-western plains of NSW. There are no historical records of this species on the Thackringa or Broken Hill 1:100,000 map sheets from the Atlas of NSW Wildlife. This species grows in dry, sandy or stony areas on the banks or in the beds of creeks, which describe the riparian areas of the project site (Map Unit 2: Riparian Chenopod Low Shrubland). This species flowers in spring early summer between August and November, so the survey period was optimum (7-10 December 2010). Furthermore, given the above average rainfall during spring/summer 2010, flowering plants and live material (including seed heads) of this species would have been visible and adequate to positively identify this species, if present.

* Refers to EPBC Act and/or the TSC Act listing and the RoTAP (rare or threatened Australian plant) code. RoTAP codes: 3 = geographic range in Australia greater than 100km; K = poorly known; and - = reserved population size not accurately known.

7.2.2. Fauna

Fauna species and habitat

Thirty seven fauna species (comprising 25 bird, seven mammal and five reptile species) were confirmed on the project site and surrounds during the field survey. No amphibians were identified. The diversity of fauna is considered to be low and reflects the small area of the site, the low diversity of habitats, lack of aquatic habitat, and lack of tree cover, logs and rocks to provide shelter for cover dependent species. The habitat on the project site is considered typical of the bioregion and chenopod shrubland habitats.

Species richness is uniformly distributed across the low shrubland landscape, with slight variations in fauna assemblages relating to the height of vegetation and soil substrates. Localised bird assemblages vary slightly with respect to the height of the vegetation. Low shrubs, less than one metre high on average, are dominated by the White-winged Fairy-wren (*Malurus leucopterus*) and Brown Songlark (*Cincloramphus cruralis*). Habitats with taller shrubs (1-3 m) are dominated by Zebra Finch (*Taeniopygia guttata*) and Splendid Fairy-Wren (*Malurus splendens*), with relict finch nests observed throughout taller shrubland areas. The taller woodland areas of Mulga (2-4 m) tend to support small populations of the larger birds, including Crimson Chat (*Epthianura tricolor*) and Singing Honeyeater (*Lichenostomus virescens*).

Fourteen habitat types were identified within the study area (refer to **Figure 7-3**). A full description of the habitat types is provided in **Appendix E.** The dominant fauna habitat type is low open chenopod shrubland.

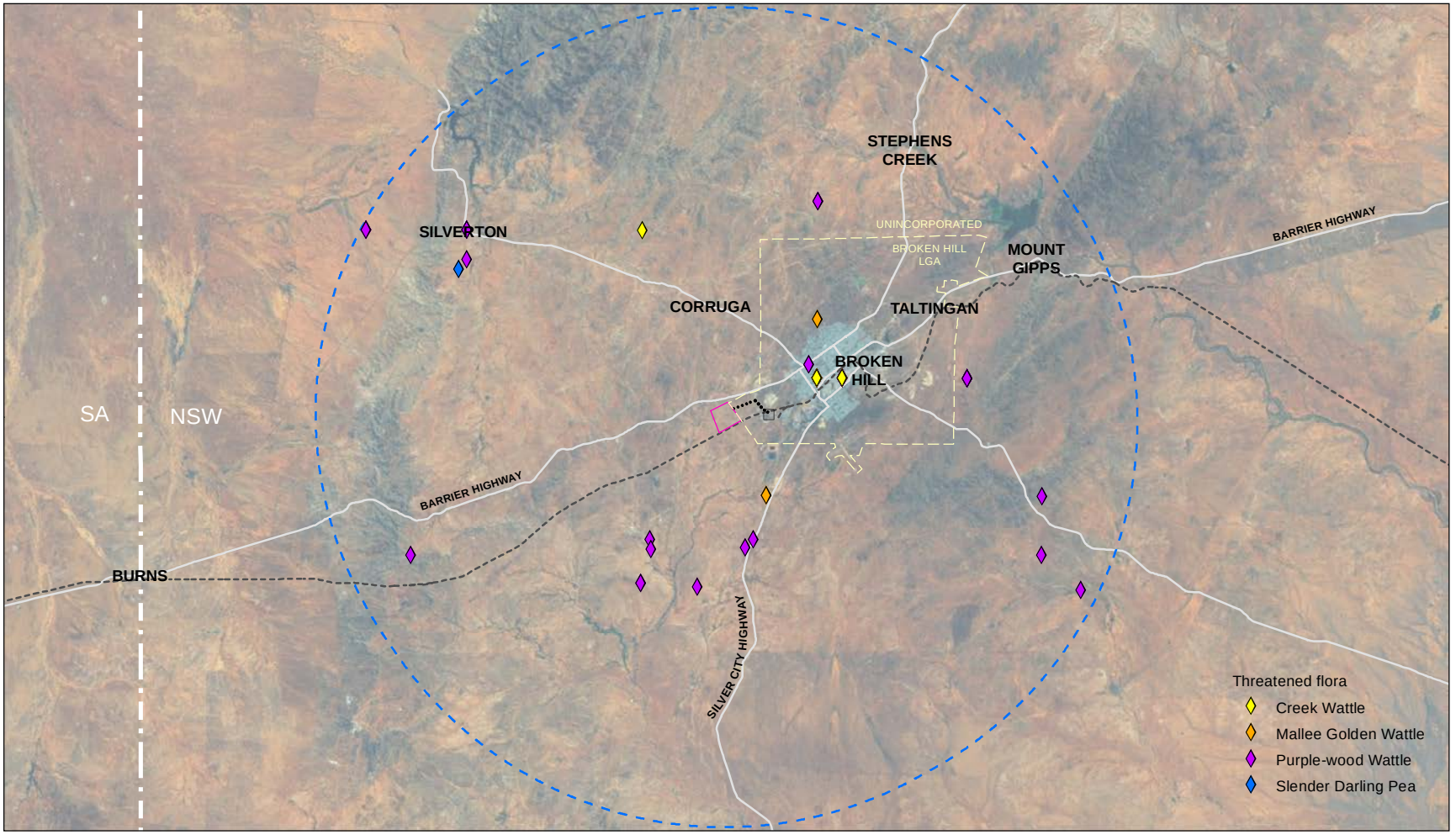

Figure 7-2 Threatened flora within 25km of the study area

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Spatial Team - Prepared by : JC
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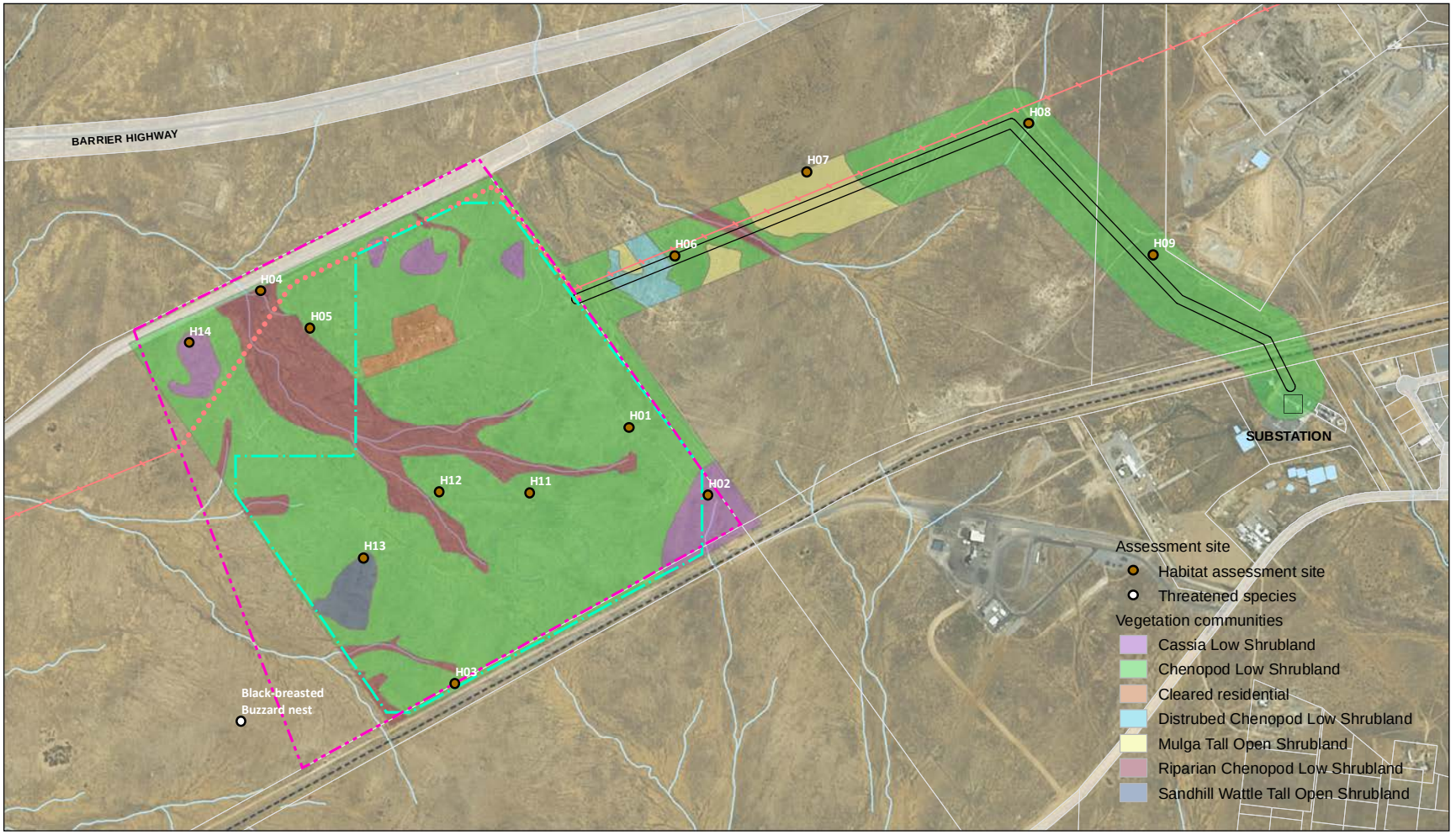

Figure 7-3 Habitat types in the study area

SINCLAIR KNIGHT MERZ

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Spatial Team - Prepared by : JC
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Because of the lack of tree cover and sparseness of shrub cover there are very limited shelter and cover opportunities for birds, small mammals and reptiles. Cover opportunities and sheltering microhabitats for reptiles (such as logs, large surface rocks and cracking clay) are virtually absent. While there are rocks scattered across the site, these are typically small or embedded in the soil and provide very limited cover opportunities. As a result, reptiles are very scarce across most parts of the project site, with the exception of two areas. Specifically, several geckos (*Gehyra variagata*) were recorded sheltering under rocks near H07, corresponding to an exposed low hill comprising large boulders and rock crevices, and the Striped Skink (*Ctenotus robustus*) and shrubland Morethia Skink (*Morethia obscura*) were recorded at H13, a low sandy hill with cover of mulga including dead trees and logs (refer to **Figure 7-4** below**)**. No suitable habitat for threatened mammal or reptile species was identified on site.

There is a drainage channel running through the centre of the solar PV plant site. This drainage channel has been affected by water erosion, resulting in exposure of bare ground, but also contains areas of tall shrubland and mulga, which provide cover and nesting opportunities for small birds. A single farm dam is located on the drainage channel at the northern boundary and comprises shallow water with grassed edges. This habitat is suited to some water dependent birds, such as the Black-fronted Dotterel (*Elseyornis melanops*) and Red-kneed Dotterel (*Erythrogonys cinctus*).

Threatened fauna

Thirty-six threatened or migratory fauna species have been previously identified or have been identified as potentially occurring within 25 km of the study area, including species listed as endangered or vulnerable under the TSC Act and the EPBC Act. The locations of previously recorded threatened fauna species, as sourced from various references as listed in Section 7.1.1, are shown in **Figure 7-4**

Three threatened fauna, the Little Eagle (*Hieraaetus morphnoides*), Black-breasted Buzzard (*Hamirostra melanosternon*) and Redthroat (*Pyrrholaemus brunneus*) were assessed as having a high likelihood of occurring within the study area. The Black-breasted Buzzard, listed as vulnerable under the TSC Act, was tentatively identified during the field survey. A large raptor was observed and was considered to be either a Black-breasted Buzzard or a Wedge-tailed Eagle. A precautionary approach was taken and the species declared to be the threatened Black-breasted Buzzard. The species was observed to be nesting on an adjacent property approximately 500 metres to the west of the project site. The nest is outside the vegetation clearance area for the project and is not considered to be directly affected. Regardless of the species, steps would be taken to avoid and minimise disturbance to the nest during construction (see **Section 7.4**). The project would remove a portion of the foraging range for these species, as well as habitat for their prey species (in particular rabbits). Further discussion on the expected impacts is provided in **Section 7.3**. The Redthroat and the Little Eagle were not identified during the field survey, although habitat in the study area is suitable for these species in the study area.

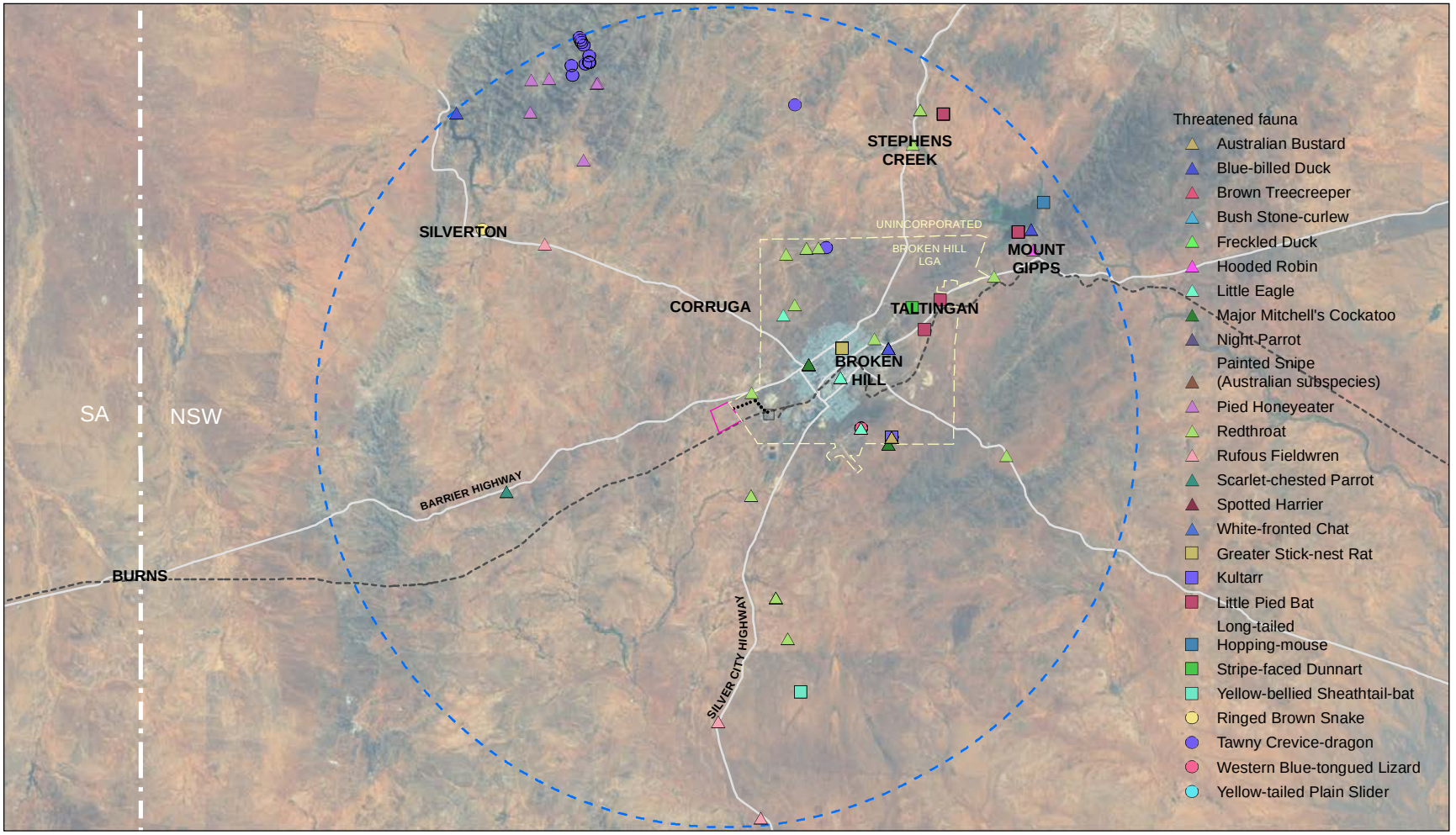

Figure 7-4 Threatened fauna within 25km of the study area

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Spatial Team - Prepared by : JC
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7.3. Potential Impacts

7.3.1. Habitat connectivity

The project would not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the project site is consistent and contiguous with the habitat in the surrounding landscape and the site is not located in an obvious wildlife corridor. The connectivity of habitat in the landscape would not be significantly affected. The project would include landscaping of the perimeter of the site, including restoration and planting of locally endemic native species. This would reduce the potential for erosion and weed invasion, provide habitat for small birds, maximise the integration of the site with the surrounding landscape, and minimise the barrier effects for small fauna.

7.3.2. Construction impacts

The construction of the solar PV plant would require clearing of shrubs and Acacias across most of the site to accommodate the plant infrastructure and internal access roads. Larger shrubs and trees would need to be removed across most of the site to accommodate the placement of the infrastructure. This would remove habitat for the majority of the fauna currently using the site, including the Black-breasted Buzzard (*Hamirostra melanosternon*). While groundcover vegetation does not need to be cleared for the solar PV plant installation, the survivability of the remaining vegetation is likely to be impacted by significant altering of the local micro-climatic conditions, in particular the introduction of permanent shade and altered surface run-off conditions from the presence of the solar panels. As a result it is expected that the current vegetation assemblage would change over time possibly becoming dominated by disturbance and shade tolerant species and/or weeds. These impacts may in turn affect resident fauna populations. It is anticipated, however, that the majority of resident fauna, including the Black-breasted Buzzard, would be able to relocate to identical areas of habitat adjacent to the site. Once site works are complete, all temporary facilities and construction infrastructure would be removed and the site would be landscaped, as appropriate. As indicated above, this would help to integrate the site with the surrounding landscape and thereby assist with fauna movement.

For the transmission line connecting to the existing substation, clearing of vegetation would be required for the placement of poles only, as the line would be constructed within an existing cleared easement. The existing transmission line that traverses the plant site will be realigned. This realignment will occur within a 20 metre easement around the north east corner of the site. At a point along the northern boundary, it will follow a route that traverses the north west corner of the site and reconnect to the existing transmission line near the western site boundary (**Figure 4-1**). Disturbance to biodiversity for the realignment in sections along the northern and eastern site boundary will not be in addition to disturbances already proposed in these locations. The section of the realignment traversing the north west corner of the project site would require access along the proposed route for construction and ongoing maintenance. Disturbance estimates include the

potential surface disturbance within the proposed 20 metre easement for this section of the realigned route. The level of disturbance required for the transmission line construction is therefore expected to be minimal. Once construction works are complete, the site would be landscaped as appropriate.

An overlay of the concept plan design was used to quantify the extent of potential vegetation loss. Based on the concept plan, the project would affect up to around 149.3 hectares of existing vegetation, as detailed in **Table 7-2**.

Noise and activity associated with construction has the potential to impact on the breeding pair of Black-breasted Buzzard. Construction should be timed to avoid breeding activity as determined by monitoring of the nest. Further details are discussed in **Section 7.4.**

Table 7-2 Area of each map unit within the project site

Map unit	Biometric Vegetation Type	Approximate impacted area (ha)
1	Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	124.6
2	Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone	13.9
3	Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland of semi-arid and arid sandplains and dunes	6.3
4	Mulga -Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions	4
5	Disturbed – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	0.5
	Total	**141.4**

7.3.3. Operational impacts

The project is expected to have a low impact on flora and fauna during operation. The presence of staff and vehicles on the site would be limited to occasional maintenance activities, which would be conducted during daylight hours. There would be no artificial night lights or noise generated from plant operation. The proposed solar PV panels absorb light and would not reflect light to any significant degree that could potentially impact the movements of birds over the site. No negative impacts on the nesting Black-breasted Buzzard are anticipated due to the operation of the solar panels.

Overall the project is unlikely to impose a significant impact on local populations of threatened species, endangered communities or their habitats as listed under the TSC Act and the EPBC Act.

This is on the basis that the site habitats are uniform and well represented across the landscape and the wider bioregion. However, it is considered that the project will contribute to the potential cumulative loss of habitat in the region in the longer term.

7.3.4. Key threatening processes

The TSC Act and *Fisheries Management Act 1994* list key threatening processes (KTP) as activities or processes that:

- Adversely affect threatened species, populations or ecological communities.
- Could cause species, populations or ecological communities that are not threatened to become threatened.

It is evident that the project would instigate some KTPs, such as clearing of native vegetation. Several other processes could be reasonably expected and are identified in **Table 7-3** along with proposed measures to mitigate impacts.

Table 7-3 Key threatening processes related to the project

KTP	Type of threat	Level of threat	Potential impacts	Impact mitigation measures
Invasion of native plant communities by exotic perennial grasses	Weed	Low	No exotic perennial grasses were identified on the site. These species are negatively associated with edge effects.	Weed management is to be developed as part of the on-site environmental management.
Competition and grazing by the feral European rabbit	Pest animal	Low-Moderate	Evidence of European rabbit was recorded on the site. The project may provide additional areas of suitable habitat for European Rabbit.	The proposed mitigation measures (including weed management and habitat restoration) would limit impacts from this KTP.
Predation by feral cats	Pest animal	Low	The project may contribute to additional predation from feral cats by attracting cats to the site during construction.	The proposed mitigation measures (in particular management of waste during construction) would limit impacts from this KTP.
Predation by the European Red Fox	Pest animal	Low	The project may contribute to additional predation from European Red Fox, by attracting foxes to site during construction.	The proposed mitigation measures (in particular management of waste during construction) would limit impacts from this KTP.
Clearing of native vegetation	Habitat loss/ change	High	The project would result in the clearing or indirect disturbance of up to 149.3 ha of native vegetation.	Where possible vegetation clearance would be minimised.
Removal of dead wood and dead trees	Habitat loss/ change	Low	The project would result in the removal of dead Acacias, however these are not currently providing important habitat due to lack of size, structure and hollows.	Dead wood and dead trees would be relocated to adjacent areas of habitat.

KTP	Type of threat	Level of threat	Potential impacts	Impact mitigation measures
Increased sedimentation and erosion during construction	Habitat loss/ change	Moderate	There is potential for increased erosion during the construction process.	The proposed mitigation measures would limit impacts and will address potential increases in wind and water erosion from loss of vegetation.
Loss of aquatic and riparian habitats	Habitat loss/ change	Low	The project would require the removal of only a narrow width of riparian vegetation and a small artificial dam. The central drainage channel is ephemeral with no standing water.	The proposed mitigation measures (in particular weed management and habitat restoration) would limit impacts from this KTP.

7.3.5. Significance assessments

An assessment of the significance of impacts was undertaken in accordance with Part 3A of the EP&A Act for threatened fauna potentially impacted by the project. The assessment concluded that the project is unlikely to impose a significant impact on local populations of threatened fauna species or their habitats given the relatively small scale of the habitat disturbance involved and the presence of similar habitats immediately adjacent to the site and in the surrounding landscape. The project would not significantly reduce the area of suitable habitat occurring in the surrounding landscape or the wider bioregion. The site habitat was not found to support unique or significant areas of habitat for threatened flora or fauna.

No nationally threatened flora and fauna species listed under the EPBC Act were identified on the project site and no such species are expected to occur. A formal assessment of significance under the guidelines of the EPBC Act is therefore not required. The project site does not provide unique or critical habitat, preferred habitat, or habitat of significance for any migratory species. Construction of the project would not affect the visitation rates and behaviours of migratory species in the region.

7.4. Impact Mitigation and Management Measures

The proposed measures to mitigate the ecological impacts of the project are as follows:

- The amount of native vegetation clearing would be restricted to the minimum area necessary for construction. Clearing boundaries would be specified within a construction environmental management plan and delineated on site with appropriate boundary or exclusion fencing to prevent unnecessary damage or clearing of vegetation and habitat.
- Vehicle speed reduction measures would be installed along internal access roads to minimise the incidence of wildlife mortality from construction and operation vehicles.

- A ‘no-go’ buffer zone of 500 metres in radius would be placed around the Black-breasted Buzzard nest site, if present at the time of construction. No construction vehicles or personnel would enter this ‘no-go’ area unless assessing the presence of this species.
- In order to minimise the impacts of construction noise and activity on the Black-breasted Buzzard nest, the following steps are recommended:
  - Avoid construction during the breeding season (August to October) if possible.
  - Prior to construction, check and monitor the nest over a three day period to determine if the nest is active or inactive.
  - If active, postpone construction until after young have fledged. This is to be determined by a fortnightly check of the nest.
  - Following construction, monitor nesting activity during the annual breeding season to determine if the nest is being used. If there is evidence of abandonment of the nest after a period of three years, further consultation is to be conducted with OEH regarding options for the placement of an artificial nest structure.
- On site waste management practices would prevent attracting or encouraging feral animals to the site during the construction period.
- Degraded portions of the site outside of the impact footprint would be restored to a) reduce the potential for wind erosion, b) improve opportunities for fauna habitation and movement across the landscape, and c) reduce the risk of weed invasion. These areas would include a) the site perimeter, b) areas that are not impacted by infrastructure and access road footprints, and c) areas that do not need to be kept clear of vegetation for maintenance purposes or safety.
- Site restoration and revegetation activities will occur during construction and post-construction.
- Appropriate weed management strategies would be implemented during construction and operation.

Residual impact after the implementation of mitigation measures will be minimal.

7.5. Biodiversity Offsetting Measures

The assessment has identified and quantified the impacts on biodiversity including the loss of habitat for threatened species in keeping with the principals for biodiversity offsets in NSW (http://www.environment.nsw.gov.au/biocertification/offsets.htm).

The project aims to maintain or improve biodiversity over time. To achieve this, a biodiversity offset strategy will be prepared. This would identify a proposed offset site, the vegetation types to be preserved and outline measures to manage the site including reducing current threats to biodiversity. The offsetting measures should also include a plan to restore and remove threats from the proposed undeveloped portions of the site. This will be achieved through appropriate landscape

vegetation planting as described in **Section 5.4**. Further consultation with OEH, Department of Primary Industries (Catchment and Lands Division) and the Lessee will occur to confirm the boundaries of the offset area. It is anticipated that the offset area will be located in the western portion of the Western Lands Lease and will be approximately 150 ha. Further contributing to the offset area will be an additional 60 ha of land within the site boundary that is not used for the solar PV plant. Therefore a total of approximately 210 ha are being offered as an offset.

8. Aboriginal Heritage

This chapter summarises the key findings of the Aboriginal Heritage Assessment undertaken for the project. Further details of the Indigenous Heritage Assessment, including the assessment methodology, can be found in the complete *Aboriginal Heritage Assessment* report, which is attached as **Appendix F**.

The Director-General's Requirements

The Environmental Assessment must include an assessment of the potential impact of the project components on indigenous heritage values (archaeological and cultural). The Environmental Assessment must demonstrate effective consultation with indigenous stakeholders during the assessment and in developing options to avoid or mitigate unavoidable impacts (including the final recommended measures) consistent with Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation (DEC, July 2005).

The following stakeholder comments have been addressed in the preparation of this chapter:

Issues raised	Chapter location
Office of Environment and Heritage (formerly Department of Environment, Climate Change and Water)	
The EA should address and document the information requirements set out in the DECCW guideline "Aboriginal cultural heritage consultation requirements for proponents 2010" involving surveys and consultation with the Aboriginal community.	Section 8.1
Identify the nature and extent of impacts on Aboriginal cultural heritage values across the project area including the transmission route and associated access tracks.	Section 8.3
An assessment of the impacts on Aboriginal cultural heritage and the action that will be taken to avoid or mitigate impacts or compensate unavoidable impacts.	Section 8.4
The EA should clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations.	Section 8.1 and Section 8.2.3
Lower Murray Darling Catchment Management Authority	
The need to preserve and respect the Indigenous heritage of the area, particularly during the construction phase.	Section 8.3
Department of Primary Industries (formerly Land and Property Management Authority)	
Impacts on European and Aboriginal cultural heritage, including full outline of survey methods and results, and methods for minimising impacts on identified sites and artefacts.	Sections 8.1, 8.3

8.1. Assessment Methodology

The assessment of Indigenous heritage impacts involved:

- A search of all relevant registers to identify the presence of any previously recorded Aboriginal heritage sites or places within or near the project site.
- A Native Title claims search.
- A review of relevant literature, including previous reports, academic studies and published works on the history and ethnography of the Broken Hill area.
- An advertisement was placed in the local Broken Hill newspaper, the Barrier Daily Truth on 20 November 2010, requesting expressions of interest for stakeholders to be involved in the preparation of the cultural heritage assessment. This is included in the Aboriginal Archaeological Assessment (see **Appendix F**).
- Pedestrian field survey to identify and record all cultural heritage sites and objects within and adjacent to the project site.
- Assessments of the significance of recorded sites and the identification of appropriate management strategies.
- Completion of documentary evidence for sites and objects located during the field survey.

The database searches included the Australian Heritage Database (which includes the Register of the National Estate) and the Aboriginal Heritage Information Management System (AHIMS) administered by the NSW OEH. The AHIMS search covered an area within a five kilometre radius of the project site.

The field survey was conducted over four days (24 to 26 November 2010 and 24 March 2011) with the participation of representatives from the Broken Hill Local Aboriginal Land Council (BHLALC). Standard archaeological field survey and recording methods were employed.

A total of 19 foot traverses were made across the solar PV plant site and transmission line easement, with transect locations selected to cover each of the relevant landform elements identified (refer to **Section 8.2**). The length of each transect was generally a function of its coincidence with a landscape feature and/or its intersection with a man-made feature such as a vehicle track, power line easement and/or fence line. The width of each transect was around 80 metres. For the proposed transmission line route, the pedestrian survey covered the full length and width of the transmission line easement, as well as areas adjacent to the easement.

A key focus of the transect survey was to ensure that all ephemeral channels and associated alluvial fans across the project site were subject to concentrated visual inspection given that this landform type is most likely to contain Aboriginal objects. Graded tracks were also examined where possible

because they provided good ground surface visibility and allowed sampling access to all other landform types.

The Aboriginal assessment was undertaken in accordance with the *Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation 2005.* Aboriginal community consultation was undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010). The 2010 consultation guidelines supersedes and is consistent with the 2005 Guidelines referred to in the above DGRs. As such consultation complies with both the 2005 and the 2010 guidelines.

Copies of the draft Aboriginal Heritage Assessment were submitted to the three Registered Aboriginal Parties on 26 July 2012 for review and comment as part of the legislated 28-day comment period. One response was received, noting that they had no further comment. No responses or feedback was received from the other parties (see **Appendix F**). As such the cultural significance of Aboriginal objects through consultation with registered parties has been assessed as far as practicable. This would be continued as part of the Aboriginal Heritage Management Plan for the project.

8.2. Existing Environment

8.2.1. Background

Pre-history

The Barrier Ranges were home to the Bulali or uplands people, who are said to have been a sub-group of the Wilyakali people whose range extended from Broken Hill to Olary (100 kilometres to the west). Although not a large population, they are said to have been permanent dwellers of the area. In the vicinity of Broken Hill, there is extensive evidence of Late Pleistocene occupation along the Darling River, ranging from 27,000 Before Present (BP) to the present, as well as earlier dates from the Lake Mungo area (ranging from 33,000 to 24,000 BP).

Some recording of early interaction between explorers and Aborigines exists, although documented records are unreliable. After the onset of European occupation, traditional Aboriginal life quickly ceased to exist in its pure form, with populations being decimated by disease and direct conflict with the colonists. Conflict continued until the 1870s when the Aborigines slowly became part of the pastoral economy.

Previous environmental impact assessment studies and surveys

Previous environmental impact assessment studies and surveys carried out in the vicinity of the Broken Hill area have led to the recording of several Aboriginal artefacts and sites. The following sections provide a summary of the key findings from previous studies of relevance to the project locality.

Previous studies of the Living Desert area

Archaeological surveys conducted in the vicinity of the Living Desert area, immediately to the north of the City of Broken Hill, have found that:

- Intensive Aboriginal exploitation of quartz reefs has occurred throughout the hills, especially where rock outcrops are present.
- Remains of large complex campsites occur in the upper creeks.
- Less abundant, less varied archaeological materials occur on low ridges and the undulating uplands landforms.
- Rare but well-delineated quartz blade workshops and artefact scatters occur on some ridges, perhaps indicating areas that were used as day camps and 'lookouts' overlooking valleys or waterholes.

Sites and artefacts recorded previously in the Living Desert area include:

- A rock engraving site, which is the only known engraving site in the area immediately surrounding Broken Hill.
- Rock holes with stone lids (Gnamma holes).
- Heat retainer ovens and oven complexes.
- Quartz reef quarries.
- Artefact scatters and isolated artefacts.

Previous studies of The Pinnacles area

The Pinnacles, which comprise three rock peaks, are located approximately seven kilometres to the west of the project site and were gazetted as an Aboriginal place in 1996. Sites and artefacts recorded previously in the vicinity of The Pinnacles include:

- Artefact scatters.
- Campsite material, including ovens and food processing equipment such as grinding dishes.

The majority of the artefacts identified during previous surveys of The Pinnacles area were found along and in close proximity to Pine Creek and Stirling Vale Creek.

Studies carried out for the Bemax Mineral Separation Plant

The impact assessment carried out in 2001 for the Bemax Mineral Separation Plant, which is located immediately to the southeast of the project site, identified 16 sites including open campsites and quartz quarries. The campsites appeared to be associated with ephemeral water courses and occasionally were found to contain heat retainer ovens. Quarry sites comprised low density artefact scatters associated with bedrock quartz outcrops.

Studies carried out for Silverton Wind Farm

The impact assessment carried out in 2008 for the Silverton Wind Farm identified 262 sites containing Aboriginal objects or evidence of occupation. The majority of these sites (i.e. 166 or 63.4 per cent) were distributions of predominantly quartz stone artefacts. Additional finds included:

- 78 quartz outcrops with evidence of exploitation.
- Fourteen sites containing stone artefacts with heat retaining hearths.
- Three isolated artefacts.
- A complex of two small circular stone arrangements.

As a result of this 2008 study, the following pattern of artefact type and distribution was noted:

- The ridge crests and slopes possess primarily quartz artefacts in a widespread but generally low density distribution. The majority of quartz outcrops, including very small and insignificant exposures, possess evidence of their use as stone procurement sites.
- A greater abundance of quartz artefacts are found in areas where quartz outcrops are present. The majority of stone artefacts are flakes and cores that have not been retouched, although a number of retouched tools were also recorded.
- Drainage depression landforms and flats associated with creek lines possess a relatively higher artefact density and diversity of artefact types. A higher percentage of foreign stone is typically present in the artefact assemblages and stone heat retainer ovens/hearths are common.

8.2.2. Registered Aboriginal heritage sites in the vicinity of the project

The preliminary environmental assessment carried out for the project in 2010 included an AHIMS database search. This revealed 55 previously recorded Aboriginal heritage sites within a five kilometre radius of the proposed solar PV plant site and transmission line easement. When placed in their locational context, it is apparent that the majority of these sites are situated in relatively close proximity to watercourses, particularly Stirling Vale Creek and its tributaries. Of the 55 recorded sites, only 17 are located within two kilometres of the project site and the majority of these are artefact scatters (refer to **Table 8-1**). There are no previously recorded or registered Aboriginal sites within 500 metres of the project site boundaries.

Table 8-1 AHIMS registered sites within two kilometres of the project site

Site ID	Site name	Distance to project	
		PV plant site	Transmission line easement
23-4-0081	AS1	1.4 km	920 m
23-4-0082	AS3	1.4 km	900 m
23-4-0083	AS4	1.2 km	950 m
23-4-0084	AS5	1.1 km	1.3 km

Site ID	Site name	Distance to project	
		PV plant site	Transmission line easement
23-4-0085	AS6	1.8 km	110 m
23-4-0086	AS7	920 m	1.2 km
23-4-0087	AS8	920 m	1.5 km
23-4-0088	AS9	700 m	720 m
23-4-0089	AS10	700 m	560 m
23-4-0090	AS12	820 m	540 m
23-4-0091	AS16	560 m	800 m
23-4-0092	AS15	640 m	1 km
23-4-0093	AS14	475 m	680 m
23-4-0111	AS11	1.7 km	540 m
23-4-0112	AS2	1.9 km	700 m
23-4-0107	AS13	1.4 km	620 m
23-4-0615	SU278/L9	1 km	-

In addition to the registered sites located within two kilometres of the project site, 'The Pinnacles' (AHIMS Site # 31-1-0019), while located 6.7 kilometres distant, is noteworthy for the following reasons:

- It is a declared Aboriginal Place and as such is recognised to be of considerable cultural significance to the local Aboriginal community.
- It is a prominent landscape feature visible on the western skyline of the Broken Hill area.

8.2.3. Existing environment within the project site

General field observations

The project site has been subject to a number of activities and land uses that have resulted in disturbance of the ground surface and hence potential loss of evidence of past Aboriginal occupation. Based on the general field observations carried out during this environmental assessment, the following conclusions were drawn regarding the nature and type of archaeological records likely to be found:

- The ephemeral nature of the water courses within and adjacent to the project site suggests that ancestral Aboriginal groups would not have camped in the area in large numbers or for long periods.
- Clearing since European settlement is likely to have precluded the presence of scarred trees.
- The bedrock geology contains quartz, which may be suitable for artefact manufacture.
- Bedrock geology is not sedimentary and hence grinding grooves are not expected to be found, especially given the intermittent nature of water flow within the area.

- The skeletal nature of the sand and gravel deposits across the project site precludes there being sufficient sediment for the interment of ancestral Aboriginal remains.
- The effects of both water and wind erosion is likely to mean that Aboriginal objects, if found, will not be *in situ* or associated with significant archaeological deposits.

Predictive modelling

A model for predicting the likely occurrence and distribution of Aboriginal heritage sites in the landscape was developed for the project, based on the environmental contexts of the project site and the desktop review of the known local and regional archaeological record. This model identified a number of landform elements within the project site and allowed the following predictions to be made:

- Landform element 1 (ephemeral drainage channels and associated alluvial fans) - archaeological evidence is likely to be sparse but there may be evidence of focused activity (e.g. one-off camp sites). Isolated stone artefacts and/or low density artefact scatters are the most likely site type to be associated with this landform element.
- Landform element 2 (colluvial slopes) - archaeological evidence is likely to be sporadic if present at all, especially at distances more than 200 metres from water.
- Landform element 3 (quartz rich units of the Proterozoic metasediments) – while stone artefact extraction sites have the potential to be associated with this landform element, the limited nature of bedrock exposures within the project site, combined with the variable nature of the quartz rich rocks and their inter-bedding as metasediments, substantially reduces the likelihood of the occurrence of stone quarries.
- Landform element 4 (graded tracks) – graded tracks cross all other landform elements within the project site and provide good ground surface visibility. As such, they have the potential to yield archaeological material.

Survey results – Aboriginal sites recorded within the project survey area

The archaeological survey carried out as part of this environmental assessment identified 14 Aboriginal archaeological sites (refer to **Table 8-2**)[2]. Of these 14 sites, 11 are located within the proposed solar PV plant site footprint and one is located within the transmission line easement. The remaining two sites are located outside the project footprint. The majority of the identified sites are located in bare alluvial fan washout areas associated with the narrowly incised ephemeral drainage

2 Site boundaries are frequently arbitrarily determined (Burke & Smith, 2004). For this survey, on ground perception that two Aboriginal objects were greater than 25 metres apart resulted in them being recorded as separate ‘sites’.

channels that trend from southeast to northwest across the project site. The identified sites comprise isolated stone artefacts and low density stone artefact scatters, as described in **Table 8-2**.

Table 8-2 Aboriginal archaeological sites recorded during the project site survey

Site number	Site type	Location	Landform element
BHS-1	Isolated Artefact	Outside impact footprint	1 - Ephemeral drainage channels
BHS-2	Isolated Artefact	Outside impact footprint	1 - Ephemeral drainage channels
BHS-3	Isolated Artefact	Outside impact footprint	1 - Ephemeral drainage channels
BHS-4	Isolated Artefact	PV plant site	1 - Ephemeral drainage channels
BHS-5	Isolated Artefact	PV plant site	1 - Ephemeral drainage channels
BHS-6	Isolated Artefact	PV plant site	1 - Ephemeral drainage channels
BHS-7	Isolated Artefact	PV plant site	1 - Ephemeral drainage channels
BHS-8	Isolated Artefact	PV plant site	1 - Ephemeral drainage channels
BHS-9	Artefact Scatter	PV plant site	2 - Colluvial slopes
BHS-10	Isolated Artefact	Outside impact footprint	1 - Ephemeral drainage channels
BHS-11	Artefact Scatter	Transmission line easement	1 - Ephemeral drainage channels
BHS-12	Artefact Scatter	Within cadastral boundaries of PV plant site but outside plant footprint	1 - Ephemeral drainage channels
BHS-13	Isolated Artefact	Outside impact footprint	1 - Ephemeral drainage channels
BHS-14	Isolated Artefact	PV plant site	1 - Ephemeral drainage channels

Ground surface visibility was generally good across all transects surveyed, ranging from 50 to 90 per cent in all but one transect where ground surface disturbance associated with the decommissioning of the Old Adelaide Road reduced visibility to 25 per cent. Given the generally good ground surface visibility and the systematic sampling of all landform elements, it is considered that the project site has been adequately surveyed for its archaeological potential. It is acknowledged, however, that surveys provide only a representative sample of the survey area and it is possible that additional undetected Aboriginal sites may be present. On the basis of the results achieved in this survey and the comparable nature of these results with those found in similar contexts elsewhere in the local area and region, any undetected sites present are unlikely to be large or complex. If present, the most likely type of undetected site would be an isolated artefact.

The archaeological evidence recovered in this survey is consistent with the broader archaeological record of the Broken Hill area. A predominance of isolated finds and/or low density artefact scatters at or nearby a main ephemeral channel is a frequently observed phenomenon in this arid environment. It is a function of both the lack of available water (and its corresponding effect on the capacity of the environment to support large groups of people) and the processes of wind and water erosion which have acted to reveal Aboriginal objects in disturbed contexts.

Aboriginal community input

Representatives of the BHLALC actively participated in the field survey work carried out as part of this environmental assessment. In the surfaces of the alluvial clay pans associated with the recorded site BHS-11 (refer to **Table 8-2**), one of the BHLALC representatives raised the possibility that hearths associated with baked clay anthills might be discernible. There was, however, insufficient evidence to confirm the presence of a hearth. Moreover, the archaeological record determined for the project site consists only of isolated finds and/or low density artefact scatters and does not provide any indication of long-term Aboriginal use or occupation of the area.

Heritage significance of the recorded sites

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. The overall heritage value of a site, place or area is a product of its cultural, scientific and public significance.

Cultural significance

This area of assessment concerns the importance of a site or features to the relevant cultural group - in this case the Aboriginal community. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for their sites and the continued protection of these sites. This type of significance will not always be consistent with the interpretations made by archaeologists - a site may have low scientific significance but high Aboriginal significance, or vice versa.

The cultural significance of the archaeological sites located within the study area was addressed during the field survey, which was carried out with the participation of BHLALC representatives. The Aboriginal participants in the field survey did not indicate that there was any known site or area within the project site that held specific cultural significance for the wider Aboriginal community. Nevertheless, discussions with the Chair of the BHLALC raised the view that stone artefacts, wherever deposited, represent the *in situ* use of that landscape by ancestral Aboriginals at some-time in the past. Furthermore, it was noted that the highly significant Aboriginal Place “The Pinnacles” was a dominant feature on the western horizon of the study area, and the use of the landscape of the study area by Aboriginal people was therefore expected given its close relative proximity to such an important site.

The cultural significance of the archaeological sites located within the study area was also addressed in the Aboriginal consultation process, which was carried out in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010). This supersedes the 2005 Guidelines referred to in the above DGRs. As such consultation complies with both the 2005 and the 2010 guidelines.

Scientific significance

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits. This type of significance relates to the ability of a site to answer current research questions and is influenced by the site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. In general terms, any Aboriginal object can contribute information about an area's Indigenous history.

The scientific significance of the Aboriginal archaeological materials recorded during the field survey of the project site is considered to be low. The only Aboriginal object types identified were non-complex isolated stone artefacts and low density stone artefact scatters. These Aboriginal object types are common in local and regional contexts. Similarly, as is also common in the local area and region, the majority of the identified artefacts were in close proximity to ephemeral channels. Moreover, the raw materials used to manufacture the artefacts (quartz, silcrete and chert) are commonly used within the region and the artefact types identified do not represent a complex assemblage of local or regional significance. Additionally, the nature of the landscape in which the artefacts were identified implies that they are no longer within their original depositional context. This means that there is very little likelihood of the artefacts being associated with intact stratigraphic deposits or revealing information about the nature, extent or patterns of past Aboriginal occupation.

Public significance

Sites that have public significance are those that that can educate people about the past. By increasing knowledge about why sites are important to the Aboriginal and scientific community, sites can be protected from ignorant or inadvertent destruction. This in turn should increase the likelihood of maintaining an archaeological resource into the future. For a site to have high public significance it should contain easily identifiable and interpretable elements, and be relatively easily accessed.

Artefact sites are generally difficult for the lay-person to appreciate without interpretative aids. If an artefact scatter is in some way outstanding (either in terms of spatial size or artefact density) it may be recognisable by the lay person and hence interpretable, but if not, this site type is usually assessed as having low public significance.

The public significance and/or educative value of the Aboriginal archaeological materials recorded during the field survey is considered to be low to moderate. In their current context they will

remain exposed to the forces of wind and water erosion, which will reduce their detectability over time. Additionally, the relative low density and low complexity of the identified artefact assemblage provides little incentive for an interested public to travel to see. This is especially so given the widely advertised alternative that the desert sculptures and associated Aboriginal and biodiversity walk provides just to the north of Broken Hill.

The salvage and transfer of the identified Aboriginal artefacts to the BHLALC provides an opportunity for the artefacts to be used to reinforce Aboriginal cultural traditions and their association and linkages to the landscape. This is especially the case if the salvaged objects are accompanied by a report detailing the landscape context from which they have been retrieved.

Native Title

The results of the Native Title Claims search identified one Native Title Claim – submitted by the Barkandji Traditional Owners #8 to the National Native Title Tribunal. The application was lodged on the 8 October 1997 and the claim was added to the Register of Native Title Claims on 3 November 2006.

8.3. Potential Impacts

The field survey identified 14 Aboriginal heritage sites within or in close proximity to the project impact footprint (refer to **Figure 8-1**). The potential for these sites to be impacted by the project is as follows:

- 11 sites (BHS 1-9 and BHS 13-14) are located within the construction footprint of the solar PV plant and have the potential to be directly impacted.
- One site (BHS 12) is located within the cadastral boundaries of the proposed solar PV plant site but outside the identified fenced area where the solar PV plant would be contained. Impacts on this site can be avoided with the application of appropriate management measures.
- One site (BHS 11) is located within the proposed transmission line easement and has the potential to be impacted. Impacts on this site could, however, be avoided through careful management of pole placement and easement access.
- One site (BHS 10) is located approximately 85 m south east of transmission line easement within a Crown reserve. Impacts on this site can be avoided through the application of appropriate management measures.

The identified Aboriginal sites comprise isolated artefacts and artefact scatters and have been assessed as having a low scientific significance and a low to moderate public significance. While the Aboriginal participants in the field survey did not indicate that there was any known site or area within the project site that held specific cultural significance for the wider Aboriginal community, there is evidence that the study area and the associated artefacts have some cultural significance.

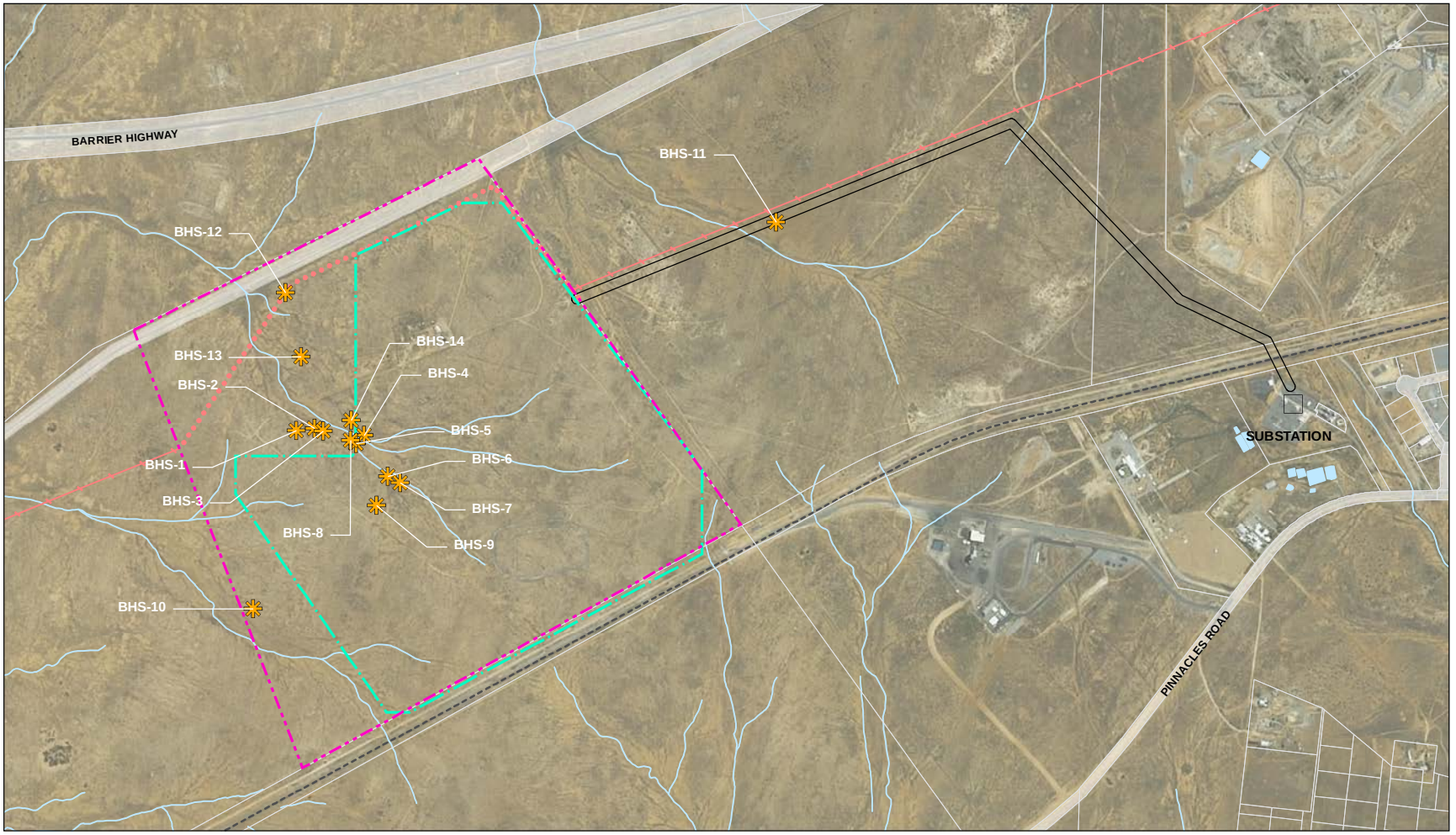

Figure 8-1 Location of Aboriginal sites within the study area

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Spatial Team - Prepared by : JC
Checked by : JL

It is considered that the salvage and transfer of the identified Aboriginal artefacts to the BHLALC would provide an opportunity for the artefacts to be used to reinforce Aboriginal cultural traditions and their association and linkages to the landscape.

8.4. Impact Mitigation and Management Measures

Management of the 14 Aboriginal heritage sites recorded during the survey of this environmental assessment is to be subject to further consultation with the Aboriginal stakeholders. Following this further consultation, an Aboriginal Heritage Management Plan (AHMP) would be developed to specify how the sites would be protected in-situ, relocated or salvaged. The basis for Aboriginal site management in the AHMP would be as follows:

- Sites BHS-1 to BHS-9, BHS-13 and BHS-14 are located within the solar PV plant footprint. These eleven sites are predominantly isolated finds, with one small artefact scatter. The management of these objects would be best undertaken through either: a) collecting them and moving them away from the project footprint; or b) salvaging them and placing them in the care of the Broken Hill Local Aboriginal Land Council.
- Site BHS-11, which is located within the transmission line easement, is a deflating artefact scatter that may have some hearth /ground oven material in association. Recommendations are as follows:
    - In the company of a qualified Aboriginal sites officer or archaeologist, the proponent would peg out the impact footprints of the transmission line in the vicinity of the Aboriginal heritage site.
    - If possible, the transmission line poles and access track would then be sited so as to span and avoid impacts on the artefactual material.
    - If all or some of the artefactual material cannot be avoided then collection and removal would be the appropriate management method.
- Sites BHS-10 and BHS-12 are outside the impact footprint of the project. Should any minor changes to the potential impact footprint occur, such as through changes to the fence alignment around the solar PV plant or changes in access track arrangements, the impact footprint would be reviewed to make sure it does not encroach too close to these sites. If either site falls within 50 metres of the project impact footprint, the site would be protected with appropriate fencing during the construction period and all staff and contractors would be made aware of its location legislative protection requirements under the NPW Act 1974.
- The presence of significant Aboriginal cultural heritage sites would be appropriately recognised via signage, designed and/or approved by the Aboriginal stakeholders (if considered by the Aboriginal stakeholders to be appropriate).

- The proponent will develop an Aboriginal Heritage Management Plan, which will include procedures to be adopted in the event that unidentified objects or sites are located during construction. This plan will be implemented if any further Aboriginal objects or sites are located during the project.

Residual impact after the implementation of mitigation measures will be minimal.

9. Traffic and Transport

This chapter identifies the potential traffic associated with construction and operation of the project. This chapter assesses the significance of these effects and where required, appropriate mitigation measures are considered.

The Director-General's Requirements

The EA must assess the construction and operational traffic impacts of the project including:

- *Details of the nature of traffic generated, transport routes, traffic volumes, vehicle movements (both light and heavy vehicles), safety impacts, and potential impacts on local and regional roads (including impacts on the structural integrity of the road network), bridges and intersections, including any proposed road upgrades and repairs.*
- *Details of measures to mitigate and/or manage the potential impacts, including measures to control soil erosion and dust generated by traffic volumes.*
- *Details of site access roads including how these would connect to the existing road network and any operational maintenance or handover requirements.*

The following stakeholder comments have been addressed in the preparation of this chapter:

Issues raised	Chapter location
Roads and Maritime Services (formerly Roads and Traffic Authority)	
A traffic impact study including: hours and days of construction; schedule for phasing/staging of the project; traffic volumes including existing, project-related for each stage of the project (construction, operation and decommissioning) and future (including project-related traffic); traffic volumes are to include a description of the ratio of light vehicles to heavy vehicles, peak times for existing traffic and project-related traffic and transportation hours; the origin, destination and routes for employee and contractor light traffic, heavy traffic, oversize and overmass traffic.	Sections 9.2, 9.4.1, 9.4.2 and 9.4.3
A description of all oversize and overmass vehicles and the cargo to be transported.	Section 9.4.1
Access to classified roads is to be minimised and existing accesses and intersections are to be used wherever practicable.	Section 9.4.2
The shortest and least trafficked route is to be given priority for the movement of materials and machinery to minimise the risk and impact to other motorists so far as is reasonably practicable.	Sections 9.2 and 9.4.2
The impact on the public road network of project-related traffic during construction, operation and decommissioning.	Sections 9.4.3 and 9.4.4
The need for improvements to the road network, and the improvements proposed such as road widening and intersection treatments, to cater for and to mitigate the impact of project-related traffic.	Sections 9.4.3 and 9.4.4
Proposed road facilities, access and intersection treatments are to be identified and in accordance with the Austroads Guide to Road Design and relevant RMS supplements.	Sections 9.4.3 and 9.4.4

Issues raised	Chapter location
A Traffic Management Plan is to be developed in consultation with the RMS.	Section 9.5
Department of Primary Industries (formerly Land and Property Management Authority)	
Traffic generation, including proposed road and access track upgrades, and impacts on residents during transportation of the project components through Broken Hill.	Sections 9.4.3, 9.4.4 and 9.5

9.1. Assessment Methodology

The potential traffic and transport impacts of the project were assessed using the following methodology:

- The proposed access arrangements for the site have been determined.
- The road sections likely to be affected by the development have been identified.
- The existing character of the road network has been determined.
- Existing traffic levels on the road network have been determined.
- The traffic generated by the development construction and operational phases have been estimated.
- The effects associated with the development construction and operational traffic has been assessed.
- An appropriate mitigation strategy has been prepared to ensure that any potential traffic effects are kept to a minimum.

The key focus of the assessment is on the construction phase of the project, which will generate the greatest volume of traffic. Notwithstanding this, the operational phase of the project will be assessed in accordance with the Director-General's Requirements.

Detailed assessment of traffic and transport will be carried out during detailed design and following the appointment of construction contractor/s and suppliers. The detailed assessment will validate or revise the outcomes of this preliminary traffic and transport assessment and will be prepared in close consultation with RMS.

9.2. Area of Study

The assessment study area was defined as comprising the following sections of the road network:

- Barrier Highway, west of Broken Hill.
- Barrier Highway, within Broken Hill.
- Barrier Highway, east of Broken Hill.
- Silver City Highway, south of Broken Hill.

Until supply contracts have been placed for the materials needed on site, details of the origin of construction vehicles and the route they will take is not known. To account for this, the impact of construction traffic on all strategic routes to and from Broken Hill has been considered within this assessment and it is these roads which represent the traffic study area.

9.3. Baseline Description

9.3.1. Description of existing conditions

This section outlines the existing road and transportation infrastructure in the vicinity of the proposed development. The sections of the road network included in this assessment have been selected on the likelihood of them being impacted by increased construction and operational traffic.

The project, located approximately five kilometres south-west of Broken Hill city centre, will be accessed from an unclassified access road off the Barrier Highway.

9.3.2. Local road network

Barrier Highway

The Barrier Highway is a sealed two-lane, two-way Inter-State Highway that runs between Broken Hill in NSW and Peterborough in South Australia. It forms part of the inland route from Sydney to Adelaide (National Route 32) and also joins to Nyngan and the Mitchell Highway in the east. The Barrier highway, to the west of Broken Hill, has an RMS road classification of 3R. The key characteristics of this road classification, as identified by the RMS, are as follows:

- Typical Annual Average Daily Traffic (AADT) flows of 4,500.
- Speed limit of between 60-110 km/hr.
- Strategic freight function.
- Moderate levels of traffic, including freight, commercial vehicles and public transport.
- Acceptable standard of travel in relation to level of service and level of road surfacing.
- Serve inter / intra- regional functions.

The Barrier Highway, to the east of Broken Hill, has an RMS road classification of 2R. The key characteristics of this road classification, as identified by the RMS, are as follows:

- Typical AADT flows of 1,500.
- Speed limit of between 60-110 km/hr.
- Strategic freight function.
- Low levels of traffic, including freight, commercial vehicles and public transport.
- Acceptable standard of travel in relation to level of service and level of road surfacing.
- Serve inter / intra- regional functions.

Silver City Highway

The Silver City Highway is a sealed two-lane, two-way Intra-State Highway that runs between the Barrier Highway in Broken Hill, NSW and the Stuart Highway in Buronga, NSW. The Silver City Highway has an RMS road classification of 1R. The key characteristics of this road classification, as identified by the RMS, are as follows:

- Typical AADT flows of 500.
- Speed limit of between 60-110 km/hr.
- Very low levels of traffic, including freight, commercial vehicles and public transport.
- Acceptable standard of travel in relation to level of service and level of road surfacing.
- Serve inter / intra- regional functions.

Proposed Site Access

The proposed site access road is an unclassified, unsealed road of reasonable quality which provides direct access from the Barrier Highway to the project site boundary. The road currently serves the existing lessee on the Western Lands Lease 14240 and will continue to do so during the operational life of the solar PV plant. In consultation with Department of Primary Industries, Catchment and Lands Division, the subdivision of Western Lands Lease 14240 will also provide for an easement to be placed over the existing access road, providing the existing lessee with continued access to the western portion of the lease. The junction onto the Barrier Highway is un-formalised, and the track itself has a minimum width of eight metres.

The proposed access road in relation to the Barrier Highway is detailed within **Figure 1-1**.

9.3.3. Baseline traffic data

Existing traffic flow data at the locations detailed within **Table 9.1** have been provided by RMS. The data from counters 1, 2 and 3 were obtained in 2005, while the data from counter 4 was obtained in 2009.

The information collected provides details of total combined AADT flows. The AADT calculation takes into account any holiday and seasonal variations and provides an accurate representation of background traffic levels throughout the whole year.

Traffic flow information for the following peak periods has also been provided by RMS at each of the counters:

- AM Peak – 08:00 – 09:00.
- PM Peak – 17:00 – 18:00.

Traffic flow data on the proposed access road has been derived by the existing lessee on Western Lands Lease 14240. Existing traffic flows are extremely low given the location, make-up and purpose of the access. Furthermore, it is unlikely that any of the daily traffic flow movements will occur during the traditional AM and PM peak periods.

Table 9-1 Traffic counter locations

Reference	Counter Description	Direction of Flow	Counter Reference
1	Barrier Highway, East of Broken Hill	Combined (two-way)	RMS 98.076
2	Silver City Highway, South of Broken Hill	Combined (two-way)	RMS 98.002
3	Barrier Highway, South of Gypsum Street, Broken Hill	Combined (two-way)	RMS 98.223
4	Barrier Highway, West of Broken Hill	Combined (two-way)	RMS 98.079
5	Proposed Access Road	Combined (two-way)	-

A summary of all traffic flow data from RMS is provided within **Table 9.2.**

Table 9-2 Traffic flows from measured data

Reference	Traffic Counter Location	Combined (Two-way) Traffic Flows		
		AADT	AM Peak (08:00-09:00)	PM Peak (17:00-18:00)
1	Barrier Highway, East of Broken Hill	886	47	50
2	Silver City Highway, South of Broken Hill	388	24	24
3	Barrier Highway, South of Gypsum Street, Broken Hill	2002	141	139
4	Barrier Highway, West of Broken Hill	466	22	35
5	Proposed Access Road	16*	0	0

*Note: This figure is not AADT as the data was sourced from the existing lessee of the Western Lands lease

9.4. Potential Impacts

An assessment of the potential impacts on the road network associated with vehicle movements during construction and operation of the development has been undertaken and described in this section.

9.4.1. Description of construction traffic

During the construction period, personnel would travel to the project site by private car, Light Goods Vehicles (LGVs) or coach. In addition to these vehicles, a number of Heavy Rigid Vehicles (HRVs) would require access to the site.

Specific activities associated with each vehicle type are as follows:

- **Shuttle buses**: Coaches would be used to shuttle construction staff to and from the site daily from the direction of Broken Hill.
- **Cars**: Where bus use is not feasible, private vehicles would be used to commute to and from the construction site.
- **Utilities**: Utilities would be used within the construction site to transport construction material and equipment. They would also be used for local pick up of materials.
- **Standard trucks**: Trucks would be the main vehicle types for transport of materials and equipment to the site from Broken Hill. There would be a number of truck movements per day for the delivery of materials, equipment and machinery. The dimensions of standard trucks are assumed to be 12.5 metres in length and 2.5 metres in width, in accordance with Austroads Design Vehicles 2006.
- **Standard articulated trucks**: Standard articulated trucks would be used to transport the required modules and inverters. Additional trucks are also anticipated to be required for the transport of switchgear, electrical conduits and cabling, steel posts, tilt brackets, module tables, clips, drainage pipes, sand bedding, machinery and materials for construction of the works, site office and maintenance building. The dimensions of standard articulated trucks are assumed to be 19 metres in length and 2.5 metres in width, in accordance with Austroads Design Vehicles 2006.
- **Over size vehicles:** A number of oversize vehicles would be required over the course of the project to transport transformers and transmission line poles. Earth moving machinery will also be transported in but this is considered minimal.

Construction activities would be undertaken during the standard hours for construction works, as follows:

- 7:00am to 6:00pm Monday to Friday.
- 8:00am to 1:00pm Saturdays.
- No work on Sundays or public holidays.

It is possible that construction outside the above-listed times may be required at some critical stages during the construction phase. Any construction or commissioning activities outside these standard working hours would require separate approval under the provisions of the POEO Act (see **Section 1.6.4**). Any affected local residences would be informed of the timing and duration of the proposed activities, prior to the commencement of any works.

9.4.2. Proposed construction access

The Barrier Highway, Silver City Highway and the proposed access road will be used to transport equipment, materials and construction workers to and from the solar PV plant site during its construction.

Given the Barrier and Silver City Highways' are major transport routes, all construction traffic associated with the project would be successfully accommodated within the carriageway extents at all times. Once preferred access route(s) for construction traffic are identified by the construction contractor, a Traffic Assessment will be undertaken to assess the merits of each route and ensure that they can successfully accommodate the proposed loads.

The detailed Transport Assessment would be prepared in consultation with RMS and Broken Hill City Council and would also include:

- A swept path analysis,
- Detailed examination of access requirements for the site, and
- Confirmation whether modifications or upgrades are required for the access road or its intersection with the Barrier Highway.

Based on preliminary consultation with RMS, the intersection of the site access road with the Barrier Highway will require upgrading to allow for safe entry and exit of vehicles from the site, and to maintain the efficiency of traffic flow on the Barrier Highway. Upgrades may include a dedicated turning lane and a passing lane on the Barrier Highway, and a paved turning area off the highway in the road verge. AGL will work with RMS to develop and implement required intersection upgrades.

The access road to the site entry gate would be upgraded with compacted gravel to provide an all-weather (unsealed) road capable of accommodating the load of construction vehicles during all weather conditions. The access road upgrade would also provide access for ongoing plant operations and would improve access for the lessee of Western Lands Lease 14240.

An unsealed perimeter road along the plant boundary would be established during the initial phase of construction and would enable access to different areas of the project site for construction and operation activities. Importantly the internal perimeter road will enable equipment to be moved from temporary construction and staging areas to the construction work fronts across the site.

Internal access roads within the plant would be constructed or upgraded to an engineered standard to facilitate plant construction and operations and to minimise generation of dust.

A parking area with approximately 60 spaces would be provided for buses and private vehicles during the construction phase. It is possible that additional on-site parking would be required during peaks in construction activity. These would be made available within the main working area of the project construction site.

The proposed transmission line would be constructed across a number of private unnamed, unsealed roads. These roads carry only very low volumes of intermittent traffic and it is therefore unlikely that the construction of the transmission line would cause significant disruption to private access or traffic flows.

9.4.3. Potential construction traffic impacts

The potential effects of construction traffic associated with the solar PV plant can be categorised as:

- Additional traffic volumes associated with project travelling on the existing road network.
- Delays to non-development related journeys as a result of slow moving vehicles, e.g., HRVs.

Table 9.3 details the potential total *weekly* and *monthly* traffic generated throughout the course of the construction period. A conservative and robust assessment has been carried out whereby peak construction traffic movements have been applied across the entire construction phase, representing a worst case scenario. In reality, the traffic movements in non-peak construction periods will be considerably less. **Table 9.4** shows the estimated increase in traffic on the road network as a result of the construction activities. The predicted percentage increase at each counter location has been derived by dividing the estimated daily construction traffic flow estimated to pass each counter location with the baseline AADT flow at each counter location.

Details of the origin of construction vehicles and their transport route will not be known until supply contracts are in place. It is therefore assumed that given the project site's proximity to Broken Hill, the vast majority of vehicles will route to / from the site via Broken Hill. As a conservative basis for this assessment, it has been assumed that 100% of construction traffic will pass each of the counter locations.

As outlined in **Table 9.3,** the total number of off-site vehicle movements estimated during construction would be approximately 58,344 over the entire construction period. This figure includes 26,520 car movements, 17,680 LGV movements, 8,840 HRV movements and 5,304 coach movements. **Table 9.3** indicates that this equates to an average of 60 car movements, 40 LGV movements, 20 HRV movements and 12 coach movements per day throughout the construction period, equalling 132 vehicle movements per day.

For the purposes of this preliminary traffic assessment it is important to note that the construction period is assumed to be approximately 17 months long. Therefore, the associated construction traffic would also be temporary and short-term.

Table 9-3 Estimated peak construction traffic movements

Vehicle Type	Estimated Peak Movements		
	Daily	Monthly	Total for Construction Period
Cars	60	1,560	**26,520**
LGVs	40	1,040	**17,680**
HRVs (up to and including B-Double)	20	520	**8,840**
Coaches	12	312	**5,304**
Total	**132**	**3,432**	**58,344**

Table 9-4 Percentage increase in traffic from construction activities

Counter location	% Distribution at Each Counter	Maximum Percentage Increase in Monthly Traffic Movements for Construction Period
Barrier Highway, East of Broken Hill	100%	28.3%
Silver City Highway, South of Broken Hill	100%	6.6%
Barrier Highway, South of Gypsum Street, Broken Hill	100%	14.9%
Barrier Highway, West of Broken Hill	100%	34%
Proposed Access Road	100%	825%[3]

The following section discusses the potential impacts of construction traffic on key sections of the road network over the construction period.

Barrier Highway, East of Broken Hill

The Barrier Highway (east of Broken Hill) is designed to accommodate approximately 1,500 vehicles per day according to the RMS road classification hierarchy. From traffic data, its base flow is 886 vehicles per day and has sufficient capacity to accommodate additional vehicle movements. The overall construction traffic volumes at this point are expected to increase by a maximum of 14.9%. This is an additional 132 vehicles per day on a base flow of 886 per day, a total of 1018 vehicles per day. The proposed total vehicle movements, therefore remain within the

[3] Where existing traffic levels are exceptionally low (e.g. on some unclassified roads), any increase in traffic flow from base flows is likely to result in a high percentage increase. Given that the conservative estimates of peak construction traffic numbers are estimated to be relatively low, 132 per day, the percentage increase is not considered to accurately reflect the ability of the road to accommodate the additional traffic.

carrying capacity of the Barrier Highway and are unlikely to adversely impact highway traffic at this location over the construction period.

Silver City Highway, south of Broken Hill

The overall traffic volumes at this point are expected to increase by a maximum of 34% on a base flow of 388 vehicles per day. An estimated additional 132 vehicles per day would be introduced during the construction period. This potential increase is unlikely to adversely affect traffic at this location, given the overall low volume of traffic movements, the low percentage increase and the temporary nature of the construction period.

Barrier Highway, within Broken Hill

The Barrier Highway (within of Broken Hill) is designed to accommodate approximately 4,500 vehicles per day according to the RMS road classification hierarchy. From traffic data, its base flow is 2,002 vehicles per day and has sufficient capacity to accommodate additional vehicle movements.

The overall traffic volumes at this point as a result of construction traffic are expected to increase by a maximum of 6.6%. This is an additional 132 vehicles per day on a base flow of 2,002 per day, a total of total of 2,134 vehicles per day. The proposed total vehicle movements, therefore remain within the carrying capacity of the Barrier Highway (at this location) and are unlikely to adversely impact the operation of traffic over the construction period.

Barrier Highway, west of Broken Hill

The Barrier Highway west of Broken Hill is designed to accommodate approximately 4,500 vehicles per day according to the RMS road classification hierarchy. From traffic data, its base flow is 466 vehicles per day and has sufficient capacity to accommodate additional vehicle movements. The overall traffic volumes as a result of construction traffic are expected to increase by a maximum of 28.3%. This is an additional 132 vehicles per day on a base flow of 466 per day, a total of 598 vehicles per day. The proposed total vehicle movements therefore remain within the carrying capacity of the Barrier Highway west of Broken Hill and are unlikely to adversely impact highway traffic over the construction period.

Proposed site access

The overall traffic volumes on the proposed site access road as a result of construction traffic are expected to significantly increase (**Table 9-4**). The base flow of traffic on the access road is approximately 16 vehicles per day. The proposed construction of the solar PV plant will contribute a maximum peak of 132 vehicles per day, a total of 148 vehicles.

The existing access road will be adequate to accommodate the increased traffic as the overall number of vehicles movements is relatively low.

Summary of Effects of Construction Traffic

The preliminary assessment of traffic and transport presents a worst case assessment of the potential impacts associated with construction traffic, where the following key assumptions have been adopted:

- Peak construction traffic numbers have been applied across the entire construction period. In reality, the volume of traffic during the majority of the construction period will be less than the estimates presented in this assessment.
- It has been assumed that all construction traffic will pass each of the traffic counter locations.

All existing public roads are designed to accommodate the proposed construction traffic. RMS road classification hierarchy has been used as a key indicator that enables the carrying capacity of the public road to be identified. The proposed increase in traffic associated with construction is small relative to existing vehicle movements and the carrying capacity of the Barrier and Silver City Highways.

The site access road will experience the largest increase in traffic movements during construction relative to its base flow. However, the total vehicle movements is still relatively small, 148 vehicles per day, and will be carefully managed through implementation of a Traffic Management Plan.

Detailed design and additional information from construction contractor/s and suppliers will enable a detailed Traffic Assessment to be undertaken to verify or revise the above outcomes. The detailed Traffic Assessment will be undertaken collaboratively with RMS and Broken Hill City Council. Agreed road upgrades and proposed management measures will be detailed in the Traffic Management Plan for the project.

9.4.4. Potential operational traffic impacts

Operational vehicles would use the internal access roads for carrying out maintenance activities on the solar PV plant. The main perimeter road would allow easy access across the site. Internal access roads would be maintained to facilitate movement within and around the solar PV plant. Employees engaged in operation and maintenance would have the use of an on-site designated parking area.

Plant operations would require up to four vehicle movements per day to transport up to two workers to and from the solar plant. This level of activity would not result in a significant increase in traffic volumes or affect traffic flows on any roads, or obstruct any public or private access.

Periodic maintenance would also be carried out on the transmission line easement and infrastructure. This would likely be carried out annually or on an as-needs basis. Access to the transmission line easement for maintenance purposes would be from the solar PV plant site. It is

anticipated only one vehicle would be required for maintenance. The volume of traffic associated with transmission line maintenance would be negligible and would not affect the capacity of any regional or local roads.

9.4.5. Potential cumulative impacts

The construction of the project may coincide with construction of the Silverton Wind Farm project. The Silverton Wind Farm is located in the Barrier Ranges with the south western boundary approximately 25 kilometres northwest of Broken Hill. The wind farm project would require equipment to be transported along local roads and would result in additional traffic along local roads.

Because AGL will be constructing both the Silverton Wind Farm and the solar project, it will be possible for AGL to develop the Traffic Management Plans for each project to manage cumulative traffic impacts.

9.4.6. Decommissioning traffic

During decommissioning, anticipated traffic movements are likely to be similar to construction. Decommissioning activities will involve the de-construction of solar PV plant equipment and ancillary facilities. All surface equipment will be removed and transported off site, all underground equipment and cabling will also be removed (to the extent practicable) prior to the area being restored and revegetation (refer to **Section 4-15** for further details). Vehicle types and numbers are likely to be similar to construction but used in reverse order. A Decommissioning Plan will be prepared for this final phase of the project and will be inclusive of a traffic assessment and management measures relevant to surrounding traffic conditions as these would have changed over the 30 year life of the project. RMS will be consulted in regard to traffic and transport aspects of the Decommissioning Plan.

9.5. Impact Mitigation and Management Measures

The following mitigation measures are proposed:

- AGL will work with RMS and Broken Hill City Council to define requirements for upgrading the intersection between the Barrier Highway and the site access road.
- All construction and operational vehicles will be required to use approved access routes to the development site.
- A Construction Traffic Management Plan will be prepared and implemented for the construction phase of the project. The plan would specify:
  - Appropriate and safe routes to and from the development along with parking and access arrangements.

  - Measures to minimise potential impacts on access routes, including timing of deliveries to minimise disruption to existing local traffic movements.
  - Speed limits and directions of travel on the access roads within the construction site, traffic control requirements, including requirements for signage, barriers and traffic control personnel.
- Erosion of the access road during construction would be managed by maintaining drainage across the landscape. This would be achieved with the construction of 'spoon drains' at regular intervals along the road.
- A road condition survey would be undertaken before construction to determine the potential impacts on the structural integrity of road infrastructure. A Construction Stage Roads Management and Maintenance Plan would then be prepared in consultation with RMS and Broken Hill Council. This plan would set out the requirements for road management, monitoring and maintenance.
- Any dust generated by construction traffic would be minimised with watering down and frequent monitoring of the road. Watering down of the road is unlikely to be necessary during operation as there would only be periodic maintenance, involving a maximum of two vehicles per day.

10. Hazard and Risks

This chapter provides an assessment of the potential hazards and risks associated with the project, including electric and magnetic fields, bushfires, potential impacts on aircraft, and the use of hazardous materials.

The Director-General's Requirements

The Environmental Assessment must include an assessment of potential hazards and risks associated with electric and magnetic fields (EMFs) (with reference to Australian Radiation Protection and Nuclear Safety Agency standards) and bushfires. The Environmental Assessment should demonstrate the application of the Principles of Prudent Avoidance in relation to EMFs. The Environmental Assessment must also consider impacts to aircraft and detail measures to contain any hazardous substances to prevent the contamination of pasture.

The following stakeholder comments have been addressed in the preparation of this chapter:

Issues raised	Chapter location
Department of Primary Industries (formerly Land and Property Management Authority)	
Methods for contamination control, and clean-up of hydrocarbon spills and other contamination.	Section 10.4.1
Human health issues associated with high-voltage electricity generation and supply.	Section 10.1

10.1. Electric and Magnetic Fields

10.1.1. Existing situation

Background

Electric and magnetic fields (EMFs) are produced by virtually all electrical equipment and occur wherever electricity is being used. The electric field is proportional to the voltage, whereas the magnetic field is proportional to the current. These fields emanate from wires delivering electricity and all devices that use electricity. Concern has been raised about the possible link between exposure to magnetic fields, in particular, and an increased risk of cancer. Electric fields are shielded by building materials and the earth, but the shielding of magnetic fields is more difficult and the easiest way to reduce exposure to magnetic fields is to increase the distance from the source.

Exposure levels to EMFs around the home are in the range of 0.01 to 0.25 microTesla (μT) [0.1 to 2.5 milliGauss (mG)]. For homes near powerlines (for example within 30 metres), these levels may be as high as 0.5-1 μT [5-10 mG] and levels of 6-10 μT [60-100 mG] may be found immediately

underneath a power line. In rural environments – away from dwellings, workshops, power lines and other electrical equipment – the power frequency of EMFs would be negligible.

Like other types of electrical equipment, transmission lines produce both electric and magnetic fields. The strength of the electric field varies generally with the operating voltage of the line whilst the magnetic field strength is related to the current (amps) flowing in the line. The field strengths are also dependent on the height of the wires above ground, their geometric arrangement and the arrangement of the phases.

Scientific basis for assessing human health impacts

There have been many decades of research on the possible health risks associated with exposure to EMFs. The most recent research confirms that, while links between EMFs and adverse health effects have not been proven, the possibility of such links cannot be ruled out (ARPANSA, 2006a).

While the authors of EMF guidelines had regard to the epidemiological and laboratory studies regarding EMFs and cancer, they considered that the available data did not provide any basis for a health risk assessment that could be used to develop exposure limits. Accordingly, the exposure limits contained in the guidelines are based primarily on established or predicted effects related to the flow of electric current within the body. They are not intended to define 'safe limits' for possible health effects, should they exist, from fields at strengths normally encountered in the vicinity of electrical equipment.

Due to continuing scientific debate about the health effects of EMF exposure, major public inquiries conducted in Australia have recommended the adoption of a policy of prudent avoidance in relation to exposure to EMFs produced by transmission lines. Prudent avoidance means looking systematically for strategies to restrict field exposure and adopting those strategies that seem to be prudent investments, given their costs and the level of scientific understanding about possible risks. In recent years, health concerns have focussed on magnetic fields rather than electric fields. For this reason, prudent avoidance is normally viewed from the standpoint of magnetic fields.

The scientific literature on EMFs is extensive, complex and inconclusive. In addressing the question of adverse health effects, this assessment has relied on the findings of independent scientific review panels and public inquiries. There is broad consensus that adverse health effects have not been established. Furthermore, although the possibility of adverse effects has not been ruled out, the research data show that the risk to human health (if any) is likely to be a small one. Nevertheless, given the current scientific uncertainty, a precautionary approach, based on a policy of 'prudent avoidance', has been adopted in selecting the alignment of the proposed transmission line that is required to connect the solar PV plant to the electricity grid.

The selection of the proposed transmission line alignment has been influenced by a number of factors, including visual impacts, impacts on the natural environment, proximity to houses, and the

overarching aim of avoiding community exposure to EMFs. As a result, the separation distance between the proposed transmission line and the nearest existing or potential dwelling is such that the magnetic fields within the dwelling would be dominated by the effects of low voltage appliances and the proposed transmission line would not add to the level of EMF exposure.

In summary, the proposed transmission line has been designed and located in accordance with a policy of prudent avoidance of exposure of people to EMFs. The transmission line would not result in any significant increase in EMF exposure in any existing or identified future residence.

Guidelines for human health protection

In November 1989, the (Australian) National Health and Medical Research Council (NHMRC) adopted and published interim guidelines for public and occupational exposure to 50/60 Hz EMFs (NHMRC, 1989). These Interim Guidelines were identical to the guidelines adopted earlier that year by the International Radiation Protection Association (IRPA) and are relevant to electricity transmission lines in Australia. The maximum acceptable public exposure levels identified by the NHMRC Interim Guidelines were as follows:

- Continuous exposure: 100 μT [1,000 mG] for magnetic fields and 5 kV/m for electric fields.
- Casual exposure: 1,000 μT [10,000 mG] for magnetic fields and 10 kV/m for electric fields.
- Occupational exposure: 5,000 μT [50,000 mG] for magnetic fields and 30 kV/m for electric fields.

The NHMRC recommended exposure limits are shown in **Table 10-1**.

Table 10-1 NHMRC limits of exposure

Exposure characteristics	Electric field (kV/m) (rms)	Magnetic flux density (μT) (rms)
Occupational exposure		
Whole working day	10	500 μT
Short term	30 (a)	5,000 μT (b)
General public exposure		
Up to 24 hours/day	5	100 μT
Few hours/day	10	1,000 μT

Notes: (a) The duration of exposure to fields between 10 and 30 kV/m may be calculated from the formula tδ80/E, where it is the duration in hours per work day and E is the electric field strength in kV/m. (b) Maximum exposure duration is two hours per work day

Up until 2006, the NHMRC Interim Guidelines were the only management guidelines for EMF exposure levels available in Australia. In 2006, the NHMRC Interim Guidelines were updated with the release by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) of a draft standard for EMF exposure (ARPANSA, 2006a). The EMF frequency range covered by this draft standard is 0 to 3 kHz, which covers the 50 Hz frequency used for electricity supply in Australia. The ARPANSA draft standard updates the requirements for management of exposure to

extremely low frequency EMFs in Australia for the general public and occupational locations. For EMF frequencies in the order of 50/60 Hz (being the frequency of relevance to transmission lines), the guidelines for safe exposure levels provided in the ARPANSA draft standard are almost identical to the NHMRC Interim Guidelines (ARPANSA, 2006b).

10.1.2. Potential impacts

EMF calculation methodology

The electric and magnetic field of a transmission line is dependent on a number of factors. Among the more tangible factors determining both the electric and magnetic field associated with a transmission line are:

- Line design and geometry.
- Distance to point of interest (i.e. height of conductors above ground). The strengths of both the electric field and the magnetic field are inversely proportional to the separation distance between the conductors and the point of interest.

Other key variables determining the electric field are the line voltage and the line current (loading), while the direction of current flow affects the magnetic field. The latter is particularly important when the resulting EMFs of several transmission lines are assessed. The combined effect of the proposed 22 kV line and adjacent 22 kV transmission lines, however, is not considered to be significant as the existing 22 kV transmission line only has the potential to increase EMF calculations by a factor of two or three, resulting in EMF values that are still significantly below the recommended limits.

The proposed 22 kV transmission line is to be built as a double-circuit line comprising 2 x 3 ACSR/GZ 54/7/3.0 (Mango) conductors in a vertical arrangement. The two circuits of the line share the load current evenly. The span between the poles is 100 metres and the sag of the conductors at the design operating temperature (85 degrees Celsius) is approximately 3.6 metres. The geometry of the conductor arrangement is shown in Chapter 4: Project description.

The electric and magnetic fields associated with the proposed line were calculated using the CDEGS proprietary software (the CDEGS software package is a set of integrated engineering software tools designed to analyse electromagnetic fields and other features).

The calculation approach was based on the guidelines Standard Basis for Quoting Transmission Line Magnetic Fields published by Energy Networks Association (ENA) of Australia.

A total line loading (both circuits share the loading equally) of 62.5MVA (50MW@0.8PF) was assumed for the magnetic field calculations. The corresponding current loading for each of the two circuits will, with certainty, be greater than the load value corresponding to ‘Typical Daily Maximum’ proposed by the ENA guideline. This conservative approach generates predicted

magnetic field levels higher than what would be expected if based on a 'Typical Daily Maximum' loading current.

The height of transmission line conductors above ground level typically varies along the line due to sag in the conductors and variations in topography. The sag of the conductors will vary depending on a number of factors, including ambient temperature, wind speed and direction, and line loading. To counter for the range of variances of these factors, the electric and magnetic fields were calculated based on a lowest hanging conductor height of 6.7 metres (Minimum Ground Clearance). This is more conservative than the ENA Standard Basis for Quoting Transmission Line Magnetic Fields, which suggests using the average conductor height above ground calculated as follows:

> *Minimum Ground Clearance (6.7 metres) plus additional height (1 metre) due to assumed operating temperature (50 degrees Celsius) being below the maximum design temperature (85 degrees Celsius) plus one third of the sag (1.1 metre) at the assumed operating temperature.*

The calculations were carried out for a straight length of the transmission line running over level land. The variations in electric and magnetic field due to the deflections in the line route are expected to be minor and are considered to be countered by basing calculations on the lowest hanging conductor height. Deflections in the line route would take place at the poles and tower (i.e. at a significantly greater height than 6.7 metres).

EMF levels calculation results

Figure 10-1 shows the total electric field (vectorial sum of the electric fields in the x, y and z-directions) one metre above the ground surface for the profile of the proposed transmission line. The electric field is identical for both sides of the transmission line because of the symmetry of the arrangement. The electric field becomes smaller with increased distance from the line.

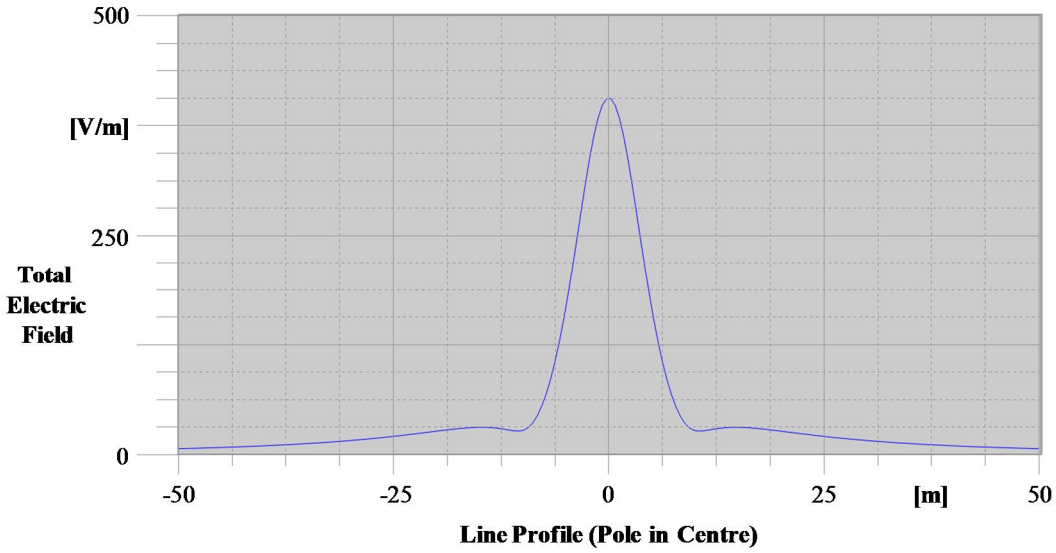

Figure 10-1 Electric field one metre above ground for 6.7m ground clearance

Figure 10-2 shows the total magnetic field (vectorial sum of the electric fields in the x, y and z-directions) one metre above the ground surface for the profile of the proposed transmission line. The magnetic field is identical for both sides of the transmission line. As for the electric field, the magnetic field becomes smaller with increased distance from the centre of the line. Note that a magnetic field of one Ampere per metre is equivalent to a magnetic flux density of 1.3 microTesla.

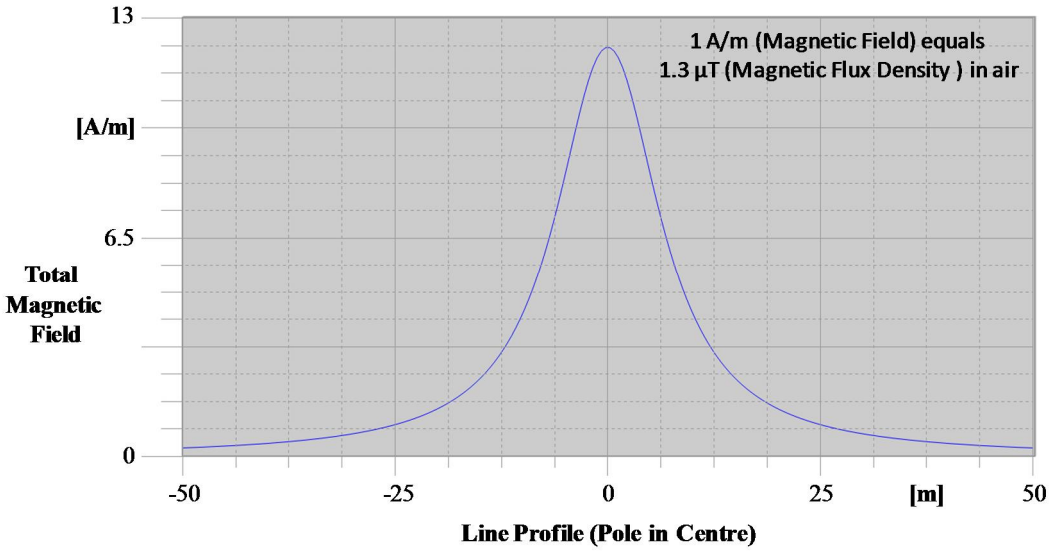

Figure 10-2 Magnetic field one metre above ground for 6.7m ground clearance

The maximum values for the electric and magnetic fields at a height of one metre above ground underneath the line and at the easement boundary (assuming a 30 metre easement) are given in **Table 10-2**.

Table 10-2 EMF one metre above ground underneath the line and at the easement boundary

	Electric Field (kV/m)	Magnetic Flux Density (μT)
Close to Centre of the Line	0.41	15.84
At Easement Boundary	0.16	1.06

The calculated electrical field strengths and magnetic flux density are well below the maximum acceptable levels as defined by NHMRC Guidelines (i.e. 5 kV/m and 100μT). Considering that no dwellings or other facilities are intended to be built and occupied within the transmission line easement, the electric field and magnetic flux density generated by the proposed transmission line is not expected to have an adverse impact on human health.

10.1.3. Impact mitigation and management measures

The results of this assessment indicate that EMFs from the proposed transmission line to connect the solar PV plant to the existing electricity grid would not have an adverse impact on human health. The alignment of the proposed transmission line has been selected in accordance with the policy of prudent avoidance with respect to human exposure to EMFs. No further impact mitigation measures are required with respect to EMFs.

10.2. Bushfire

10.2.1. Existing environment

The Broken Hill region is characterised by a warm to hot, persistently dry desert climate, which generally presents a high bush fire risk. There has, however, been no recorded bushfire or wildfire activity in the area since 2007. Given that the proposed project site is sparsely covered with low-lying shrubs and there is no bushland located adjacent to, or in the surrounding area, it is not considered to be a bushfire prone area. This risk of bushfire is considered in the environmental risk assessment (**Table 1-6).**

10.2.2. Potential impacts

Construction

Project construction activities that may cause or increase the risk of a bushfire include:

- Smoking and inappropriate disposal of cigarette butts.
- Grinding, mowing, slashing and using a petrol powered chainsaw.
- Welding and soldering.

- Using a petrol, LPG or diesel powered motor vehicle over land containing combustible material.
- Using a mobile plant fitted with power hydraulics on land containing combustible material.
- Using a gas torch to apply heat shrink cable products.
- Manual re-closing of overhead lines.

It is unlikely that the project would pose a significant bushfire risk due to the lack of existing vegetation in the project area. The bushfire hazard associated with the above-listed activities would be minimised as far as practical through the implementation of appropriate management measures, as identified in **Section 10.2.3**. With the implementation of these measures, construction of the project would not present a significant bushfire risk.

Operation

Any overhead electricity reticulation system is a potential source of ignition. Bushfires can be caused by faults in the system and by vegetation coming into contact with conductors. The bushfire hazard associated with the operation of the proposed project would be minimised as far as practical through the implementation of the management measures identified in **Section 10.2.3**. With the implementation of these measures, operation of the project would not present a significant bushfire risk.

10.2.3. Impact mitigation and management measures

Construction

- All construction work would be carried out in accordance with standard procedures, practices and guidelines for bushfires set out in relevant transmission line agency manuals and as advised by the Rural Fire Service.
- The risk of fire and its prevention would be part of the Hazard Identification, Risk Assessment and Control process to be carried out prior to work commencing.
- Contractors/work staff would be trained in how to prevent, control and survive bush fires.
- Work vehicles would be equipped with appropriate bushfire control equipment.
- Construction areas would be monitored for dust generation and appropriate dust suppression measures implemented in a timely manner, as required.
- The access road connecting the Barrier Highway to the project site and would be constructed with compacted gravel. The perimeter road and internal access roads would be constructed as required to minimise dust and erosion.
- Areas of soil disturbance would be stabilised in a progressive manner as soon as practical.
- Construction vehicles/machinery would not be left running or idling when not in use.

- Construction plant would be fitted with appropriate emission controls and would undergo periodic and regular maintenance to reduce exhaust emissions.
- Vehicular loads of spoil and other erodible material would be suitably covered during transport.
- No burning of vegetation or waste material would take place on the construction site.

Operation

- To minimise the chance of vegetation coming into contact with the transmission line and starting bushfires, the required clearances and the requirements of ISSC3 (Industry Safety Clearing Committee Guideline No. 3) of additional clearances for non urban areas would be met.
- The operator would liaise and consult with the NSW Rural Fire Service, NSW Fire Brigades, local government and other relevant government departments regarding bush fire-related matters.
- To identify any factors associated with overhead lines that could lead to the initiation of a bush fire, the operator would carry out a number of mitigation patrols, including annual aerial or ground inspections, vegetation maintenance (every 2-3 years), and pole and line inspections (every 4-5 years).

10.3. Aircraft

The proposed 22 kV transmission line is not considered to have any potential to impact aviation activities. The project site is located more than five kilometres from the closest airport at Broken Hill and the proposed transmission line poles are not high enough to affect any low-flying or landing aircraft. Glare impacts, which are addressed in Chapter 5, are not considered to be a significant issue.

10.4. Hazardous Materials

10.4.1. Use of hazardous materials during construction

The use of hazardous materials during construction presents environmental and human health risks due to the possibility of accidental spills during handling or storage. Potential impacts include pollution of waterways and contamination of land, with further consequential impacts for both ecosystems and human health.

Dangerous goods and hazardous materials that may be used during construction of the project include (but may not be limited to) diesel fuels, oils, greases and lubricants, petrol, gases (oxy-Acetylene), bitumen, paints and epoxies and herbicides. Some of these hazardous materials may be stored at the construction site.

The quantities of hazardous materials required for the project are small and are not expected to pose a significant risk of off-site or community impacts. Potential risks would be further mitigated through the implementation of standard construction site management measures, as identified in **Section 10.4.3**. The storage, handling and use of materials would be undertaken in accordance with the *Occupational Health and Safety Act 2000* and the WorkCover guideline *Storage and Handling of Dangerous Goods* (2005).

10.4.2. Use of hazardous materials during operation

The operation of the project is not expected to require the use of dangerous goods or hazardous materials.

10.4.3. Impact mitigation and management measures

Construction

- Any dangerous goods or hazardous materials stored on the construction site would be stored in a securely bunded area of sufficient containment capacity.
- Where dangerous goods or hazardous materials are to be stored on the construction site, an effective spill kit would be available for use at all times.
- Any accidental spills would be contained and cleaned up immediately.
- Major plant and equipment would be re-fuelled either off site or by a mobile mini-fuel tanker with a spill procedure and spill kit.
- Transport of dangerous goods or hazardous materials would be undertaken by an appropriately licensed contractor.
- A number of site-specific plans would be prepared and implemented for the project, including an incident management plan. This plan would identify the potential incidents that may occur during construction and the corresponding incident response procedures.

Residual impact after the implementation of mitigation measures will be minimal.

Operation

The operation of the project is not expected to require the use of dangerous goods or hazardous materials. As such, there is no requirement to identify specific impact mitigation measures for hazards and risks for the operational phase of the project. Operation of the project would be carried out in accordance with AGL's environmental policies and procedures.

11. Water Supply, Water Quality and Waterways

This chapter identifies the water requirements for construction and operation of the project and the potential impacts on surface water, groundwater and flooding. A flood impact assessment was undertaken for the project.

The key findings of the flood impact assessment are summarised in this chapter, while the complete report is attached as **Appendix G**.

The Director-General's Requirements

The Environmental Assessment must outline water requirements for the project and whether an adequate and secure water supply is available for the life of the project including the statutory (licensing)/water sharing plan context of the water supply sources, and assess potential environmental impacts associated with the identified sources, including impacts on groundwater. The Environmental Assessment must address any flooding impacts of changes to water courses including addressing soil erosion issues and the potential to create salinity risks.

The following stakeholder comments have been addressed in the preparation of this chapter:

Issues raised	Chapter location
Department of Primary Industries (formerly Land and Property Management Authority)	
Alteration to water sources, including water flow and run-off regimes, groundwater levels and quality, and likelihood of sedimentation of local water courses.	Section 11.2.1, 11.2.3
Amount, source and quality of water for construction and operation of the project, including dust suppression activities.	Section 11.2.2

11.1. Existing Environment

11.1.1. Surface water

The Broken Hill region is located in the west of the Barwon-Darling Catchment. The Barwon-Darling Catchment covers over 142,000 square kilometres and is a sub-catchment of the Murray-Darling Basin (CSIRO, 2008). The main watercourses within this catchment include the Darling River, Barwon River and associated anabranches. Low levels of annual precipitation and high evaporation rates mean that most surface waters in the Broken Hill region are ephemeral, flowing only after high rainfall or storm events (Geoscience Australia, 2008).

The project site is drained by a creek system comprising tributaries of Stirling Vale Creek. The Stirling Vale Creek catchment originates immediately west of Broken Hill. The main drainage lines on the project site flow from the south and east to the north-west. The egress point is located

approximately 400 metres east of the north eastern corner of the property boundary, where a farm dam lies within the drainage line. Overflow from the dam and any other surface flows eventually drain to the Stirling Vale Creek floodplain. Drainage within and adjacent to the site is depicted in **Figure 11-1**.

Drainage from the southern edge of the property (or upper internal catchment of the property) is typically sheet flow into shallow gullies that are generally 0.3-0.5 metres deep and 1-2 metres wide. The gullies increase in size towards the dam as flow increases. Erosion is evident along some of the lower (northern) drainage channels.

The watercourses within the project site generally fall within the following stream classifications:

- First order: Located at the base of shallow gullies. Often intermittent with limited vegetation.
- Second order: Occur where the first order watercourses converge. Located in the north of the project site.

Water quality within the Barwon-Darling Catchment is considered to be poor due to over-allocation of surface water resources, with over 30 per cent of surface water being extracted for irrigation purposes (CSIRO, 2008). Water quality in the area is affected by heavy metals, minerals and salinity, as well as algal and bacterial blooms (CSIRO, 2008).

The water supply for Broken Hill is derived from the Menindee Lakes Storage System. The Menindee Lakes are located approximately 100 km south-east of Broken Hill and provide up to 10,000 ML of water per year to Broken Hill (SWC, 2009). The Menindee Lakes are the predominant source of water for the city.

Potential flooding sources for the project site include Stirling Vale Creek, Kellys Creek and associated tributaries (refer to **Figure 11-1**).

11.1.2. Groundwater

Broken Hill is located within the Adelaide Fold Belt groundwater management unit (GMU) (Geoscience Australia, 2008). The Adelaide Fold Belt GMU covers an area of over 12,000 square kilometres and has a sustainable yield of over 59,000 megalitres per year.

The predominant source of groundwater around the Broken Hill area is the Fractured Rock Groundwater Province. Groundwater quality in this groundwater province is generally considered to be poor, with values of total dissolved solids and salinity too high for human consumption (Geoscience Australia, 2008). Water supply in this groundwater province is characterised by variable but often low yield. It supplies water for various uses including small-scale stock and domestic bores.

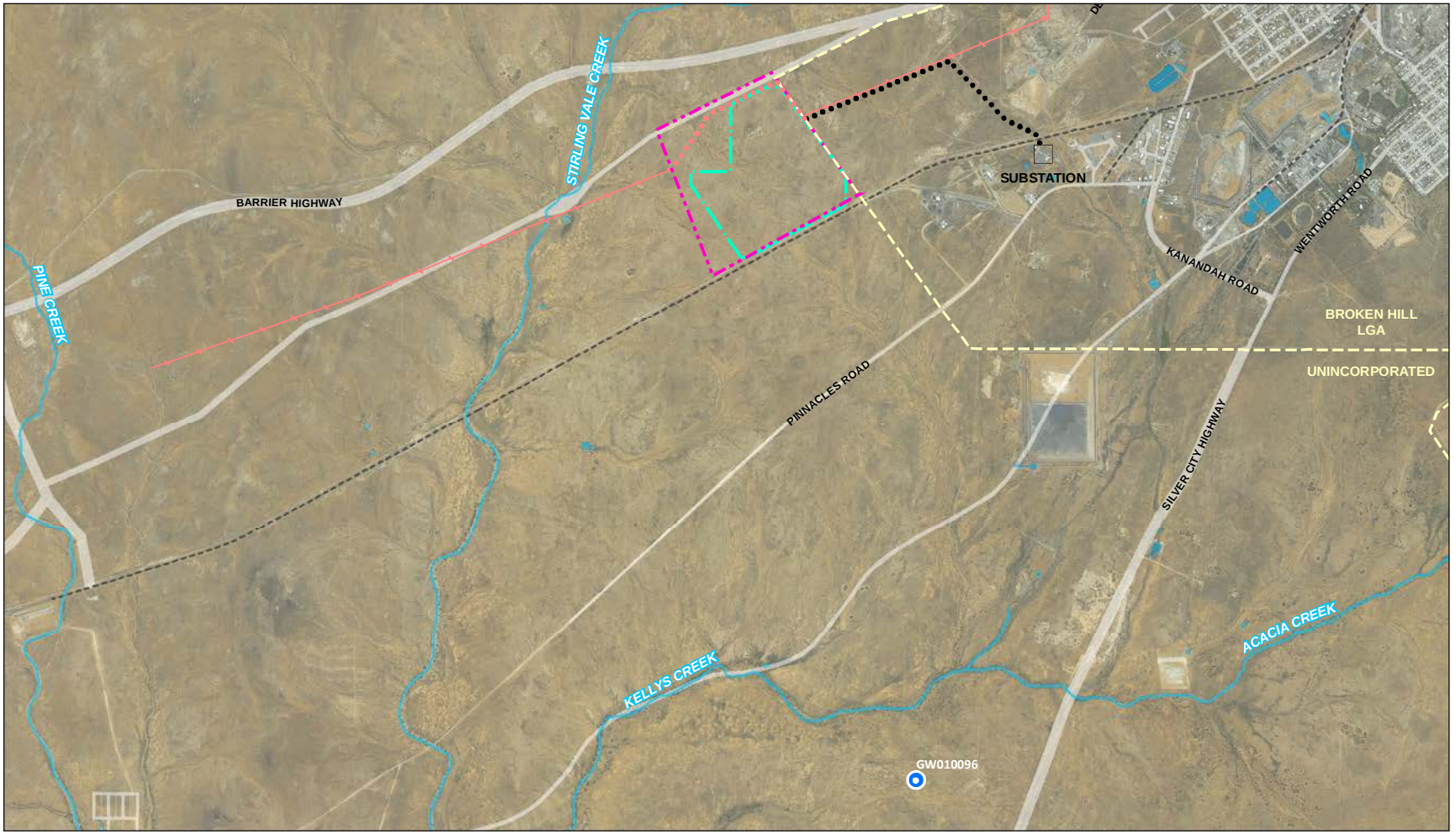

Figure 11-1 Surface waters draining the project site

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A Search of the Natural Resources Atlas website identified one groundwater bore in the vicinity of the site containing standing water level (SWL) information (**Table 11-1**). There are no groundwater bores in the study area and none on the site. Other bores in the surrounding area do not contain information relating to standing water levels or licensing information.

Table 11-1 Groundwater bore locations

Groundwater bore	Easting	Northing	Standing water level	Location
GW010096	6455133	538412	17.70 metres	Yancowinna. ~4 km south west of the project site

11.1.3. Water management

Broken Hill is located in the Western Water Management Area. The water sharing plan for the Western Water Management Area commenced on 1 July 2008, but only applies to areas within the Great Artesian Basin.

11.2. Potential Impacts

Watercourses within the project site, stream order, and potential watercourse impacts are outlined in **Table 11-2**.

Table 11-2 Watercourses, stream order and potential impact

Watercourse	Stream order	Location	Potential impact
Tributaries of Stirling Vale Creek	First order	Lot 6806 DP 823918	Eight tributaries of Stirling Vale Creek would be directly impacted (solar PV plant site intersects each of the watercourses).
Tributary of Stirling Vale Creek	Second order	Lot 6806 DP 823918	Directly impacted (solar PV plant site intersects the watercourse).
Tributary of Stirling Vale Creek	First order	Lot 6667 DP 822054	Directly impacted (transmission line crosses the watercourse).
Tributary of Stirling Vale Creek	Second order	Lot 6667 DP 822054	Directly impacted (transmission line crosses the watercourse).

11.2.1. Groundwater and surface water quality

Construction of the project has the potential to impact surface water quality as a result of:

- Soil erosion from construction areas, which may lead to off-site transport of eroded sediments, increased turbidity and sediment loads in receiving waterways, and deposition of sediments on stream beds.
- Accidental spills or leaks of oil, grease, fuel or other hazardous materials, which may lead to pollution of surface waters if not adequately contained.

The likelihood of the above-listed impacts occurring would be relatively low given that the project does not involve deep excavation, large-scale earthworks, or storage of large volumes of chemicals. Furthermore, the above-listed risks can be adequately controlled with standard construction site management measures, including standard erosion and sediment controls.

Groundwater quality is unlikely to be impacted by the project given that the project does not involve deep excavation or any activities that would result in intersection of groundwater reservoirs or infiltration of pollutants to groundwater. The project does not involve long-term storage of large volumes of fuels or chemicals.

11.2.2. Water use and supply

The amount of water required for construction of the project would be minimal. The main use of water during construction would be for dust suppression, which would be carried out on an 'as needed' basis. It is anticipated that approximately 200 kilolitres would be required per day during peak construction, inclusive of dust suppression. This water would be sourced from the local water supply, which is derived from Menindee Lakes Storage System, or from treated wastewater. Essential Water is the responsible water supply authority in Broken Hill. The use of water for dust suppression would require relatively small water volumes and would not impact Broken Hill's water supply.

No water would be required for the operation of the solar PV plant or transmission line. The solar arrays do not require any water for cleaning or operational purposes. Minimal water usage is associated with the staff facilities. This includes domestic water supply for toilets and washbasins which would be sufficient for approximately 2 people per day The volumes of water required to operate these facilities would be minor and would be sourced from either the Broken Hill water supply system (managed by Essential Water) or from a water tank storage system on site. Any water used from the Broken Hill water supply system would not have a significant impact on the Broken Hill water supply system or any other water supply sources.

The project site is located in an area that is not prone to bushfires. The surrounding vegetation presents a low bushfire risk (see **Section 10.2**). Due to this low risk, a dedicated water supply for fire fighting purposes is not required.

No groundwater would be used for construction or operation of the project. Additionally, given that the nearest groundwater bore to the project site has a standing water level of 17.7 metres, it is unlikely that excavation works during construction would intersect with the groundwater table or affect any local groundwater supply.

The construction of the project may coincide with construction of the Silverton Wind Farm project. According to the Silverton Wind Farm EA by ngh environmental (2008), the project may require

200 kilolitres of water per day during the five year construction period. This water would be sourced from the Umberumberka Reservoir.

AGL has commenced consultation with Essential Water in regards to construction water requirements for the solar project and this consultation has confirmed that sufficient water is available for the Broken Hill solar PV plant. This water would likely be sourced from the Menindee Lake system. Therefore, cumulative impacts associated with water supply are considered unlikely.

11.2.3. Flooding

Flood modelling undertaken for the project in 2010 (refer to **Appendix G**) indicated that flooding in Stirling Vale Creek does not result in elevated water levels at the project site. Modelling results also indicated, that while the existing culverts that direct flows under the Barrier Highway may be affected by flooding, resulting in flood flows over the road, surcharging water is not expected to be directed towards the project site.

Flooding within the project site would predominantly arise from three tributaries of Stirling Vale Creek, which are located within the solar PV plant site. The modelled extents and depths of flooding of these tributaries for the estimated 100 year average recurrence interval (ARI) event are shown in **Figure 11-2**. The estimated area that would experience flood depths greater than 0.5 metres is approximately 0.7 per cent (1.2 hectares) of the project site and 0.4 per cent (0.6 hectares) of the solar PV plant area. The area that would experience flood depths between 0.25 and 0.5 metres depth is approximately 1.8 per cent (3.1 hectares) of the project site area and 1.7 per cent (2.2 hectares) of the solar PV plant area.

In summary, while the project site may be affected by flooding during a 100 year ARI event, flooding would be confined to the farm dam and the main drainage lines. As such, the project is unlikely to be impacted by flooding. Similarly, the infrastructure associated with the project is unlikely to have a significant impact on flood flows, flood behaviour or associated erosion potential given the following factors:

- The project is not located on a major floodplain.
- Only a very small proportion of the project site would be affected by flooding during a 100 year ARI event.
- The project infrastructure is not located in the areas of the site that may be affected by flooding in the 100 year ARI event.
- The main project structures, including the solar panels and transmission line poles, would not result in complete obstruction of surface sheet flows.

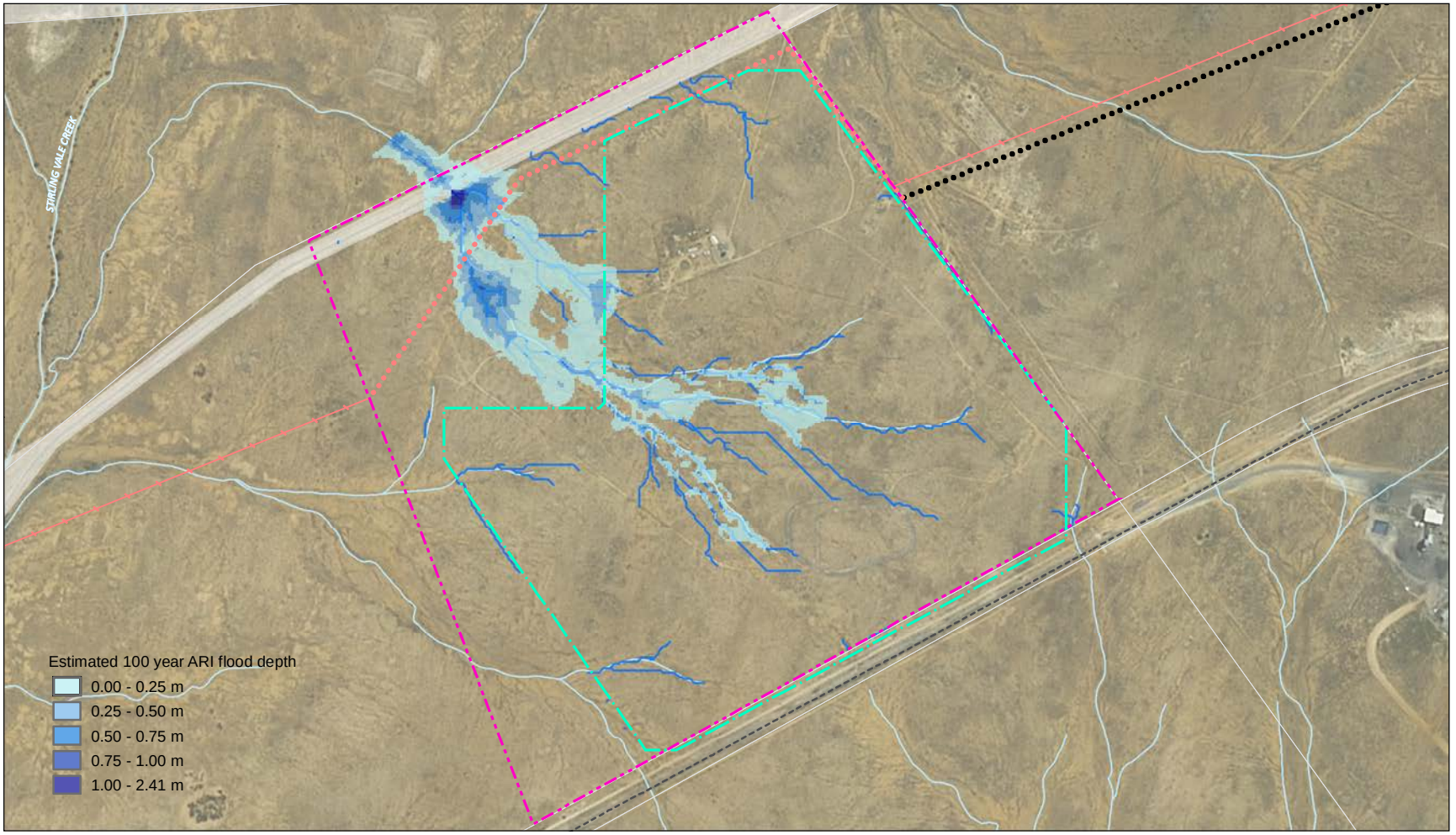

Figure 11-2 Extent and depth of flooding along major overland flow paths (100 year ARI event)

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Checked by : JL

- The site is relatively flat, with the result that surface sheet flows would be relatively slow moving. Minor changes in sheet flows would therefore be unlikely to present a significant erosion risk.
- The project does not require any modifications to watercourses.
- No infrastructure (including transmission line poles) would be placed within 40 metres of a watercourse. The transmission line would span watercourses but would have no direct impacts on these watercourses.

Site drainage would be designed so that surface storm flows are directed to the tributaries of Stirling Vale Creek in a manner that keeps changes in surface flow patterns and erosion risks to a minimum. Standard erosion and sediment control measures, in accordance with the guidelines of the 'Blue Book' (Landcom, 2006) would be implemented during construction.

11.2.4. Salinity

The risks associated with soil and groundwater salinity have been considered as part of this assessment. The project is unlikely to impact salinity given that it does not involve any activities that are likely to impact groundwater or water table levels. Specifically, the project does not involve deep excavation and is therefore unlikely to result in interception of groundwater. Furthermore, it does not involve groundwater extraction or irrigation and would therefore be unlikely to result in migration of saline groundwater to the soil surface and subsequent increases in soil salinity.

11.2.5. Run-off

It is not anticipated that water running off the solar modules would cause any concentrated erosion as there is sufficient gaps between the modules so that runoff is not concentrated. The moderate size of the modules (approximately 120 centimetres by 60 centimetres) allows the adequate dispersal of water.

A natural sheet flow of water would be maintained due to a minimal grading approach that maintains the natural compaction of the soil and natural vegetation.

11.3. Impact Mitigation and Management Measures

11.3.1. Construction

- Appropriate erosion and sediment control measures, consistent with the guidelines of the 'Blue Book' (Landcom, 2006), would be established before any clearing, excavation or ground disturbance begins and maintained in effective working order until the works have been completed and the affected ground surfaces have been adequately stabilised.
- Stock piles of spoil, fill or erodible material would not be placed within or near watercourses or drainage pathways.

- Construction traffic would be confined to existing established roads and access tracks. During construction, the site access junction with the Barrier Highway would be monitored for any build up or deposition of soil or debris. Any soil or debris tracked onto the road would be removed at the end of each work day and disposed of appropriately.
- Areas disturbed by clearing or excavation would be stabilised and restored as soon as possible using appropriate stabilisation and revegetation measures. Stabilisation and restoration of disturbed areas would take place in a progressive manner during the construction phase, where practicable. The plants used for site restoration would comprise native species endemic to the project site and suitable for the project site conditions, taking into consideration the soils, climate and shaded area under the solar PV plant panels.
- To avoid accidental contamination of receiving waterways, major plant and equipment would be refuelled either off-site or by a mobile mini-fuel tanker with spill trays and spill kits nearby.
- Any dangerous goods or hazardous materials stored on the construction site would be stored in a securely bunded area of sufficient containment capacity.
- An effective and functioning spill kit would be readily available for use at all times during construction. Any accidental spills would be contained and cleaned up immediately.

Residual impact after the implementation of mitigation measures will be minimal.

11.3.2. Operation

The operation of the project would not result in any impacts on surface water or groundwater. As such, there is no requirement to identify specific impact mitigation measures for water management for the operational phase of the project. Operation of the project would be carried out in accordance with AGL's environmental policies and procedures.

12. Assessment of Other Issues

This chapter details the environmental risk analysis undertaken for the project in accordance with the Director-General's requirements (DGRs). This chapter also provides an assessment of the other (non-key) environmental issues that may be associated with construction and operation of the project.

The Director-General's Requirements

The Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project, proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of the additional key environmental impact(s) must be included in the Environmental Assessment.

12.1. Land Use

12.1.1. Existing environment

Land use

Land use in the wider Far Western Region of NSW includes mining and agriculture (mainly dry land grazing). There are a number of mines (including abandoned mines) located in the wider region. There are no State Forests or conservation areas in the vicinity of the project.

The proposed solar PV plant site and transmission line are located on rural land. The solar PV plant site would occupy one land holding, being Crown Land. There is currently a Western Lands (perpetual) Lease on this land for grazing purposes, although no agricultural activities are currently undertaken on the site. The transmission line connecting the solar PV plant to the Broken Hill substation would traverse four land holdings, including a parcel of land owned by the Australian Rail Track Corporation Ltd (ARTC). The land holdings affected by the project are summarised in **Table 12-1** and shown on **Figure 12-1**.

Table 12-1 Land holdings affected by the project

Affected land parcel	Landholders/ Lease holders	Potential impact
PV plant		
Lot 6806 DP 823918	Les Luke & Sons Pty Ltd Western Lands Lease 14240 (perpetual lease for grazing purposes)	Directly affected by project. Site of the proposed solar PV plant.

Affected land parcel	Landholders/ Lease holders	Potential impact
Transmission line		
Lot 6667 DP 822054	Willyama Common Trust Crown Land administered by Broken Hill City Council	Directly affected by project. Transmission line would traverse this land parcel.
No Lot and DP	Willyama Common Trust Crown Land administered by Broken Hill City Council	Directly affected by project. Transmission line would traverse this land parcel.
Lot 1 DP 533250	Australian Rail Track Corporation Ltd	Directly affected by project. Transmission line would traverse the railway track.
Lot 2 DP 1102040	TransGrid	Directly affected by project. Transmission line connects to the substation on this land parcel.

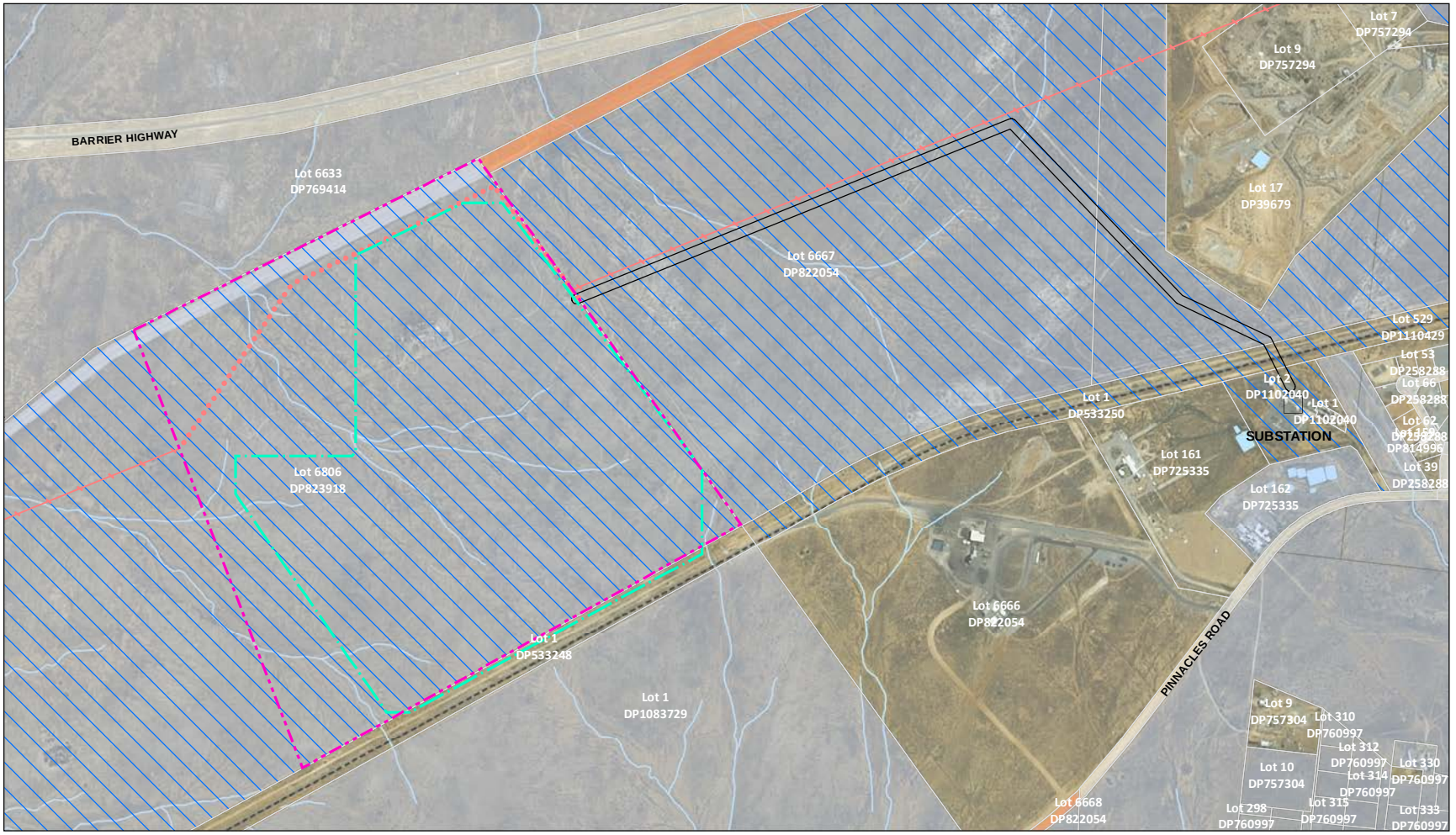
Mineral resources

Information was obtained from the Department of Trade and Investment, Regional Infrastructure and Services (Department of Energy and Resources branch) on 18 April 2011 to determine current exploration titles and applications for minerals, coal and petroleum of relevance to the project site. There are currently four Exploration Licences (EL6689, EL2921, EL6132 and EL6774) and two Consolidated Mining Leases (CML13 and CML10) over the project site, including the solar PV plant site and transmission line route (refer to **Table 12-2** and **Figure 12-2**). The *Mining Act 1992* allows for an exploration licence to be issued for the exploration of minerals and also a consolidated mining lease, which comprises a consolidation of previously existing mining leases for mining purposes.

Table 12-2 Current exploration titles and applications on the site

Title reference	Grant date	Expiry date	Last renewed	Company	Minerals	Potential impact
EL6689	2 Jan 2007	1 Jan 2011 (Renewal sought)	17 Aug 2009	Perilya Broken Hill Limited	Group 1	PV plant and transmission line
EL2921	13 Oct1987	12 Oct 2011	9 April 2010	Perilya Broken Hill Limited	Group 1	PV plant
EL6132	1 Oct 2003	30 Sept 2011	6 Aug 2010	PlatSearch NL	Group 1	PV plant and transmission line
EL6774	8 May 2007	8 May 2011	9 April 2010	Perilya Broken Hill Limited	Group 1	Transmission line
CML13	2 July 1987	14 Sept 2020	23 Dec 2008	Perilya Broken Hill Limited	Group 1 Group 2	PV plant
CML 10	2 July 1987	04 Sept 2024	23 Dec 2008	Perilya Broken Hill Limited	Various	Transmission line

Note: Group 1 (Metallic minerals); Group 2 (Non-metallic minerals)



- **Figure 12-1 Land holdings affected by the project**

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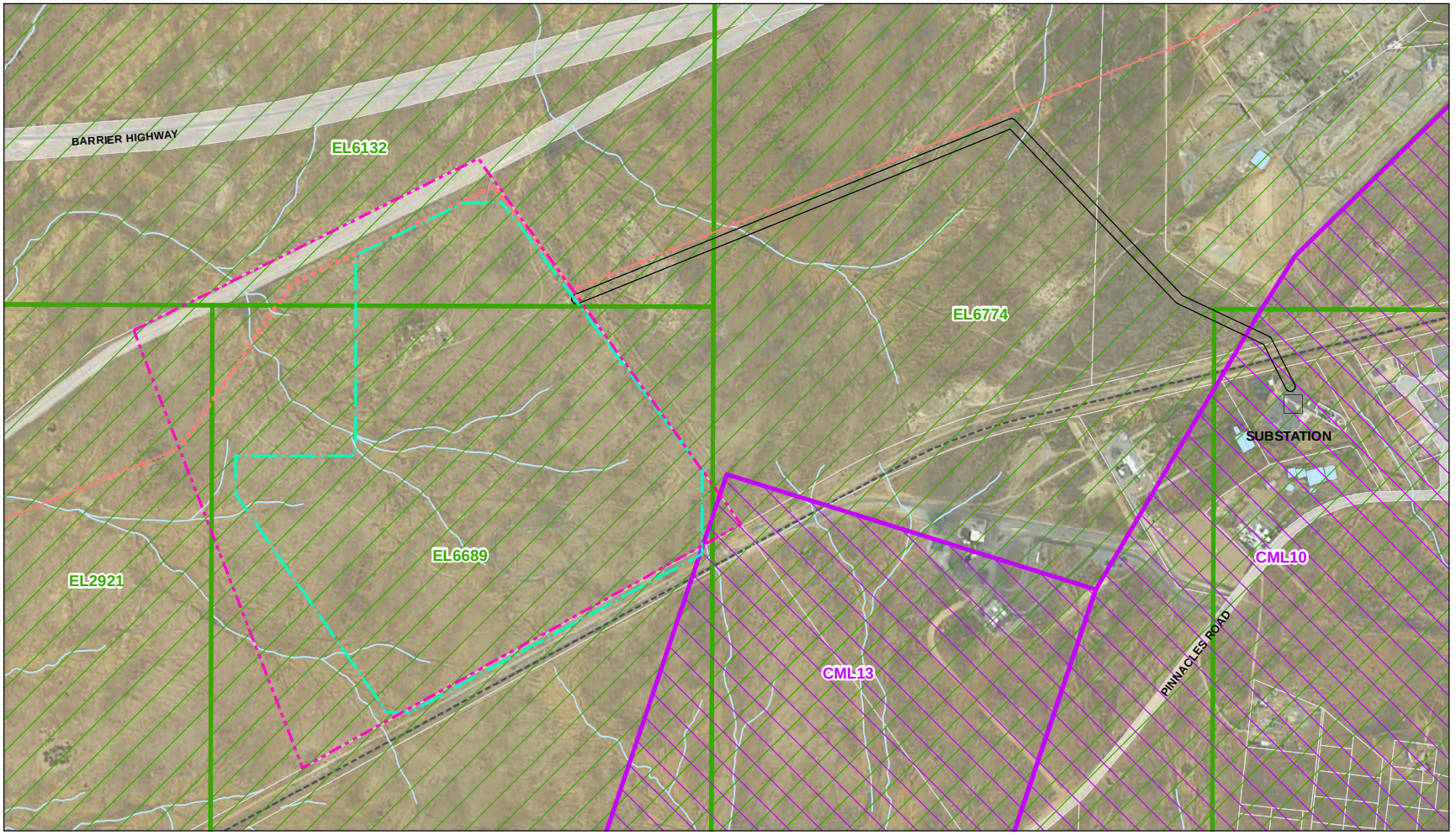

Figure 12-2 Current mineral exploration titles and applications

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12.1.2. Potential impacts

Property issues

The site of the solar PV plant is located on Crown Land (refer to **Figure 12-1**), which is administered by the NSW Department of Primary Industries, Catchments and Lands Division. There is currently a Western Lands Lease (WLL 14240) on the site for grazing purposes, although it is not currently being used for grazing or other agricultural activities. In consultation with the Catchments and Lands Division, AGL would undertake the following process to gain access to and approved use of the property:

i. subdivision,

ii. purchase and transfer of subdivided land from current lessee to AGL,

iii. surrender of subdivided land, then

iv. issue of a Section 34A lease under the *Crown Lands Act 1989*,

all of which will require authorisation from the Minister for Regional Infrastructure and Services. The change in land use from grazing purposes to solar power generation is not considered to be significant given the area of land involved in the context of its wider geography and that the site is not currently being used for any rural or agricultural activities.

Easement issues

AGL will need to obtain a 20 metre wide easement for the proposed transmission line where it traverses the land holding identified in **Table 12-2**. The acquisition of easements would allow AGL to have secure access to the transmission line for ongoing operation and maintenance. The acquisition of easements would not, however, give AGL exclusive rights to the land. Property owners would be allowed to make use of the land as long as their activities do not create a safety hazard for themselves or others, or restrict AGL's use of the easement.

Where transmission line easements cross private land or Crown land, the land owner is prohibited from erecting buildings, stockpiling materials and other activities that would alter the ground profile or otherwise affect the transmission line. Activities that do not pose a significant safety risk are allowed with permission from the owner of the easement. The acquisition of a transmission line easement would not preclude the use of the land for grazing.

Land ownership would not change as a result of the transmission line, although tenure would change as the easement would need to be negotiated over any land subject to the alignment, and reference to that easement would be noted on the land title. Where easements are acquired over private or Crown land (whether by negotiation, or by compulsory process), financial compensation is payable to the landowner in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.

An easement for private access to the proposed future residential dwelling would be maintained at the northern boundary of the site (refer to **Figure 4-1**). This easement would join to the existing access track from the Barrier Highway.

Mineral resources

As the project site is subject to exploration licences and two consolidated mining leases, there is a potential for the project to impact planned exploration and extraction activities. It is possible, however, that any short-term future mineral exploration and extraction schedules could be managed around the planned timeframe for construction. Once operational, however, the presence of the solar PV plant and the transmission line easement would prevent the carrying out of exploration and extraction activities in those locations.

The potential impacts on any planned exploration or extraction activities are considered to be low, however, given that the project intersects only a very small proportion of the areas covered by the exploration licences and the mining lease (refer to **Figure 12-2**). Specifically, the project site and associated transmission line intersects approximately:

- 6.5 hectares or 0.1 per cent of the total land covered by EL2921.
- 25.3 hectares or 0.2 per cent of the total land covered by EL6132.
- 6.5 hectares or 0.2 per cent of the total land covered by EL6774.
- 144 hectares or 1.5 per cent of the total land covered by EL6689.
- 0.85 hectares or 0.1 per cent of the total land covered by CML13.
- 0.7 hectares or 0.1 per cent of the total land covered by CML10.

Construction

There would be a temporary loss of access to the land along the transmission line route during the construction period. This is not likely to have a significant impact on any land uses as it would be constructed adjacent to an existing transmission line and associated access track. Access to the existing transmission line would remain available throughout the construction period.

The construction of the project is not expected to interfere with any other land uses surrounding the proposed solar PV plant site and transmission line route. The impacts of construction on land use would be minor and temporary and are not considered to be significant.

Operation

Operation of the project would involve routine and reactive maintenance, including periodic inspections of the solar PV plant and transmission line and (on an ‘as needs’ basis) repairs to infrastructure, trimming of trees within the transmission line easement to maintain sufficient clearance to conductors, and maintenance of the transmission line access track, which lies within

the transmission line easement. These activities are not expected to result in any impacts on land use for the following reasons:

- The activities would be minor and non-intrusive and would not generate significant noise or involve any disruptions to land use.
- There are no residences close to the proposed solar PV plant or transmission line that would be potentially impacted by any associated noise, visual or traffic impacts.
- There is no existing or planned future infrastructure on the project site.
- The transmission line would be constructed adjacent to an existing transmission line to minimise disturbance to land. This would allow land use impacts to be confined to a single area that is already impacted by transmission line infrastructure.

The acquisition of an easement for the proposed transmission line would allow the operator to gain secure access for its ongoing operation and maintenance. An easement would not, however, give AGL exclusive rights to the land. Property owners would be allowed to make use of the land as long as their activities do not create a safety hazard for themselves or others, or restrict AGL's use of the easement.

12.1.3. Impact mitigation and management measures

Construction

- Landowners or leaseholders would be informed of the construction schedule and scope of works prior to construction.
- Access to properties would not be impeded by construction activities.
- Easements and associated land use restrictions would be identified on property titles.
- Consultation would occur with current mineral licence and lease holders.
- Where the project affects Crown land, the NSW DPI and the affected leaseholder would be consulted on the arrangements for transfer or alteration of the lease.

Operation

The operation of the project would not result in any further impacts on land use. As such, there is no requirement to identify specific impact mitigation measures for land use for the operational phase of the project. Operation of the project would be carried out in accordance with AGL Energy's environmental policies and procedures.

12.2. Non-Indigenous Heritage

12.2.1. Existing environment

A search of relevant historical heritage registers was undertaken to identify the locations of non-Indigenous heritage items and places in the study area. The following heritage registers were searched as part of this environmental assessment:

- World Heritage.
- National Heritage List.
- Register of the National Estate.
- Commonwealth Heritage List.
- NSW State Heritage Register.
- Broken Hill LEP Heritage Schedule.

The results of the heritage register searches indicated that there are no recorded non-Indigenous heritage items or places on or within one kilometre of the project site. Additionally, no previously unrecorded or non-listed items of non-Indigenous heritage significance or potential non-Indigenous heritage significance were found within the proposed solar PV plant footprint or proposed transmission line easement. As such, the presence of archaeological 'relics' (as defined by the *Heritage Act 1977*) within the project footprint is considered to be unlikely.

12.2.2. Potential impacts

No known non-Indigenous heritage items or areas of non-Indigenous heritage significance would be impacted by the project, either directly or indirectly (e.g. through visual impacts). It is also unlikely that the project would result in excavation or disturbance of any non-Indigenous archaeological 'relics', as there are no previously recorded items located in close proximity to the project. It is possible, although unlikely, that unrecorded archaeological 'relics' may be present within the project footprint and could therefore be disturbed during construction. Management measures to address the potential for accidental disturbance of previously undiscovered 'relics' are identified in **Section 12.3.3**.

12.2.3. Impact mitigation and management measures

Construction

If a previously unrecorded item or site (or suspected item or site) of non-Indigenous heritage significance is uncovered during the construction phase, work would immediately cease in the area of the find. The uncovered find would be reported immediately to the Office of Environment and Heritage and advice would be sought from an appropriately qualified non-Indigenous heritage consultant concerning the appropriate course of action. Work in the affected areas would not resume until the heritage value and associated protection and approval requirements have been determined and addressed.

Operation

Operation of the project would not result in any impacts on non-Indigenous heritage. As such, there is no requirement to identify specific impact mitigation measures for non-Indigenous heritage for the operational phase of the project. Operation of the project would be carried out in accordance with AGL's environmental policies and procedures.

12.3. Socio-economic Issues

12.3.1. Existing environment

Population characteristics

An overview of the key population and demographic characteristics of the study area is presented below based on data from the Australian Bureau of Statistics (ABS) 2006 Census.

The solar PV plant site is located within the unincorporated area of NSW (i.e. it is not part of any formal local government area). The unincorporated area had a population of around 1,120 people over the 93,300 square kilometre area at the time of the ABS 2006 Census (ABS, 2006a). The unincorporated area makes up part of the Far Western Region of NSW, the most sparsely populated region in the state, accounting for 18.4 per cent of the land mass but only 0.4 per cent of the population. Ninety per cent of the population in the region live in the city of Broken Hill, the nearest city to the project site, located approximately five kilometres distant. The city of Broken Hill has a population of 18,854 (ABS, 2006b).

The median age of the population in the wider Broken Hill area (including the city of Broken Hill) is 42, which is higher than the Australian median age of 37. The percentage of people in the 55-64 age bracket and the 65 and over age bracket is also higher than the Australian average, indicating an aging population. This may have implications for sourcing a construction workforce from the local area.

Economy and employment

The Far Western Region, including the Broken Hill area, is characterised by a regional economy that is heavily reliant on local resources. The mining industry - including silver, lead, zinc and mineral sands mining - plays a central role in the economy, accounting for 20 per cent of the region's Gross Regional Product, 10 per cent of its employment and 70 per cent of its exports (Department of State and Regional Development, 2008).

The Far Western Region is also characterised by a growing agricultural industry. The agricultural sector was traditionally based on pastoral activities, however the growth of irrigation has aided the introduction of different sectors, including meat production (goat and sheep) and intensive horticulture.

Employment data show that:

- The main industry of employment is metal ore mining, accounting for 8.3 per cent of the work force.
- The commercial and services sector is a significant source of employment, with 5.3 per cent of the workforce employed in school education, 5.0 per cent in hospitals and 3.8 per cent in retail and small commercial.

- The unemployment rate for the wider area of Broken Hill is 8.9 per cent, which is higher in comparison to the overall Australian unemployment rate of 5.2 per cent.

12.3.2. Potential impacts

Construction

The potential socio-economic impacts associated with the construction of the project:

- Creation of new construction jobs for the duration of the construction period.
- Income flow into the local economy of Broken Hill.

The construction of the project at Broken Hill is likely to generate up to 197 construction jobs for an approximate duration of 17 months. It is also possible that construction workers would relocate their families to Broken Hill during the construction period. This may provide new opportunities for Broken Hill in the form of increased retail and commercial trade, including the provision of accommodation and other services.

Regional, state and national direct and indirect construction employment for the Broken Hill project is shown in **Table 12-3**. Peak employment is estimated at 220 labour positions in the region.

Table 12-3 Broken Hill regional employment impacts (direct and indirect) – construction

Construction (FTEs)	Local Regional	NSW	Australia
Direct Employment	197	235	283
Production Induced Impact	209	259	341
Consumption Induced Impact	234	288	373
Total	640	782	997

Source: AGL, 2010

The influx of more people into Broken Hill for the duration of the construction period may potentially place pressures on existing services, especially the availability of accommodation. This can be managed via a number of strategies, including maximising employment of local construction workers where appropriate staff are available and making full use of all possible accommodation options (including hotels, motels, caravan parks and rental accommodation). The requirements for additional accommodation would be further assessed during detailed design once the size of the construction workforce has been confirmed, as specified in **Section 12.4.3**.

Potential cumulative construction impacts

The construction of the project may coincide with construction of the Silverton Wind Farm project. AGL is responsible for the development of both projects. AGL estimates that approximately 150 workers will be required for construction of the wind farm. On this basis, the two projects combined would provide approximately 350 construction employment opportunities. A large

proportion of labour is generally expected to be available locally and from regional areas (SKM, 2012). In the first instance, local accommodation and services would be utilised to support the workforce. **Table 12-4** shows existing accommodation types available in the Broken Hill township that suggests sufficient capacity is available to accommodate construction workforces from both projects locally.

On this basis, potential cumulative impacts on accommodation and related services are likely to be minimal. Furthermore, both projects would benefit the Broken Hill regional economy.

Table 12-4 Accommodation available in Broken Hill

Accommodation Type	Number
Motels, Serviced Apartments – 5 to 14 rooms	6
Motels, Serviced Apartments – 15 or more rooms	12
Motels, Serviced Apartments – Total – 5 or more rooms	18
Hotels – 15 or more rooms	1
Motels – 15 or more rooms	11
Services Apartments – 15 or more rooms	0
Caravan Parks	2
Holiday Flats and Units	0
Visitor Hostels	1

Source: SKM 2012

Operation

The operation of the project at Broken Hill is unlikely to place any pressures on accommodation, education or health services. It is expected that the project would only require up to four personnel to manage day-to-day operations and maintenance activities. As such, it would have little or no socio-economic impacts.

12.3.3. Impact mitigation and management measures

Construction

Advance notification of the construction schedule, construction works and access arrangements would be given to potentially affected property owners and the broader Broken Hill community

Operation

The operation of the project would not have any significant socio-economic impacts. As such, there is no requirement to identify specific operational impact mitigation measures for socio-economic

issues. Operation of the project would be carried out in accordance with AGL's environmental policies and procedures.

12.4. Geology and Soils

12.4.1. Existing environment

A geology and soils investigation was undertaken as part of the *Geotechnical Investigation and Pile Load Testing* report (Coffey, 2010). The regional geology of Broken Hill comprises folded and metamorphosed Proterozoic Era (545-2,500 million years) sedimentary and igneous rocks and Palaeozoic Era (251-545 million years) sedimentary rocks. The Broken Hill 1:250,000 Geology Sheet (Geoscience Australia, 1970) indicates that the project site is underlain by rocks of the Willyama Complex.

Surface soils within the study area comprise clays with a sand and gravel component. The thickness of the soils generally varies from 0.8 metres to 1.3 metres, although soils greater than three metres thick were found at some locations near creek beds. The rock underlying the soil layer consists largely of gneiss and pegmatite, and occurs at a shallow depth. The rock unit is variably weathered in the upper surface, deeply weathered and low strength at some locations, but grading quickly to medium strength or high strength at other locations. Laboratory testing of the soil and rock units indicated that they have low permeability.

The project site is located in a zone of relatively low seismic hazard with a low risk of freeze-thaw actions. The geographical and topographical conditions are not consistent with acid sulphate soil environments and, given its inland location, the project site is unlikely to contain acid sulphate soils. Soils are expected to have low to medium potential for shrink-swell movements with seasonal changes in soil moisture contents.

12.4.2. Potential impacts

Construction

The potential impact of the project in relation to geology and soils is limited to an increased risk of soil erosion as a result of excavation and ground disturbance during construction.

The PV mounting structure comprises steel posts that are driven approximately 1.5 metres below ground using a pile driver. Trenches, approximately 800 millimetres deep by 600 millimetres wide, would be excavated for electrical cable installation. Existing dirt tracks on the construction site would be built-up and upgraded with hard-packed gravel. Excavation for the purpose of installation of support facilities would also occur. These activities would disturb the top soil through minor excavation and increase soil vulnerability to erosion.

The transmission line construction requires installation of approximately 14 metre high poles. Installation would involve minor excavation for the foundations and would result in top soil

disturbance. A permanent access track would be established within the transmission line, which would result in disturbance to soils through minor vegetation clearing and grading activities.

The soil erosion risks associated with the project are considered to be low given that the project does not involve deep excavation or large scale earthworks and that the topography of the site is relatively flat. Soil erosion risks can be effectively managed and controlled through the application of standard erosion and sediment control measures, such as those described in 'the Blue Book' (Landcom, 2006), and through timely stabilisation and restoration of disturbed areas.

Operation

Once operational, the project would have no impacts in relation to geology or soils. The solar PV plant site and transmission line easement would be maintained in a stable condition to prevent the occurrence of soil erosion and other forms of environmental degradation in accordance with AGL's environmental policies and procedures.

12.4.3. Impact mitigation and management measures

Construction

The erosion and sediment control and site restoration measures identified in *Chapter 11 – Water management* would be effective in minimising the risks of soil erosion during construction as far as practicable. No additional impact mitigation measures would be required in relation to geology and soils.

Operation

The operation of the project would not have any significant impacts on geology or soils. As such, there is no requirement to identify specific impact mitigation measures for geology and soils for the operational phase of the project. Operation of the project would be carried out in accordance with AGL's environmental policies and procedures.

12.5. Air Quality and Climate

12.5.1. Existing environment

Air quality

There is no historical information available on local air quality at the project site. While no air quality monitoring has been undertaken, air quality within the study area is expected to be reasonably high due to the predominance of rural land uses, low population density, lack of heavy industry and lack of large urban centres.

The State of the Environment (SoE) supplementary report for the Broken Hill LGA notes that the two most prevalent air quality issues are dust (particularly lead containing dust) and smoke from slow combustion heaters (Broken Hill City Council, 2010). Sources of dust and lead dust include

vacant land, uncovered loads, mine leases (waste rock dumps, tailings dams, haul roads and mining activities), building demolition, land clearing, and commercial and industrial activities.

Climate

The Bureau of Meteorology operates an Automatic Weather Station at Broken Hill Airport at 32.00 °S, 141.47 °E (station number 047048). The historic records over the last 63 years show that the Broken Hill area experiences a mild to hot climate with a mean maximum temperature of 24.4°C and a mean minimum temperature of 11.6°C. The summer months (December - February) are the hottest, with January having a mean daily maximum of 33.3°C. The winter months (June - August) are the coldest, with July having a mean daily minimum of 4.8°C.

The area experiences a mild seasonal variation in the distribution of rain with most rain falling during summer and spring. The driest month is June (mean monthly rainfall of 15.2 mm) and the wettest month is October (mean monthly rainfall of 26.3 mm). Mean annual wind speed is 18.2 km/h at 9am and 19.0 km/h at 3pm, and is predominantly from the south.

12.5.2. Potential impacts

Construction

The main air quality issue during construction would be the potential for generation of dust from areas of exposed soil and earthworks. The potential for dust generation would be dependent largely on the prevailing weather conditions and the amount of time that erodible materials are left exposed to wind erosion. The potential for dust generation would be greatest during dry, windy conditions.

The potential for dust generation during construction of the project is considered to be relatively low given that the project does not involve large scale earthworks. Furthermore, given the large separation distance between the project site and sensitive receivers, the potential for dust to impact human health and amenity is also low. The potential for dust generation can be readily controlled with standard construction site dust suppression measures, such as stabilising exposed soil surfaces and stockpiles as soon as possible, and the controlled application of water to dust prone areas.

All construction vehicles, plant and equipment would be properly maintained and operated and would not be a significant source of air emissions. Emissions from work vehicles and equipment would be localised, intermittent and limited to the construction period and would therefore be rapidly dispersed. These emissions would not have a significant impact on air quality.

Operation

The operation of the project would involve distribution of electricity generated by solar energy and would not generate any air emissions. This would have a positive impact on air quality and climate as it would reduce the amount of greenhouse gas emissions associated with electricity generation to meet energy demands.

Operational maintenance activities would involve up to four vehicles travelling to and from the site. The impacts of this on air quality and climate would be negligible.

12.5.3. Impact mitigation and management measures

Construction

- Construction areas would be monitored visually for dust generation so that appropriate dust suppression measures can be implemented in a timely manner.
- The access road connecting the Barrier Highway to the project site would be constructed with compacted gravel to facilitate the expected load of construction vehicles. The perimeter road and internal access roads would be constructed to an engineered standard to facilitate vehicle movement within the plant and minimise dust and soil erosion.
- Areas of soil disturbance would be stabilised in a progressive manner as soon as practical.
- Work vehicles/machinery would not be left running or idling when not in use.
- Plant would be fitted with appropriate emission controls and would undergo periodic and regular maintenance to reduce exhaust emissions.
- Vehicular loads of spoil and other erodible material would be suitably covered during transport.
- No burning of vegetation or waste material would take place on the construction site.

Operation

Operation of the project would not have any adverse impacts on air quality. As such, there is no requirement to identify specific air quality impact mitigation measures for the operational phase of the project. Operation of the project would be carried out in accordance with AGL Energy's environmental policies and procedures.

12.6. Waste Management

12.6.1. Existing environment

A waste depot operated by Broken Hill City Council is located approximately one kilometre from the Broken Hill residential area, about 300 metres south of the Barrier Highway and 700 metres north of the Adelaide-Broken Hill Railway. The depot provides for:

- Domestic waste disposal.
- Processing of green waste, compost and food waste.
- Construction waste disposal.
- Waste oil storage.

The waste depot receives more than 10,000 tonnes of domestic waste, 6,000 tonnes of commercial waste, 10,000 tonnes of building/demolition waste, 5,600 m^3 of industrial waste and 7,000 tonnes of green waste annually (BHCC, 2005).

12.6.2. Waste management framework

The waste management practices associated with the project would be guided by the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) and the Western Subregional Waste Management Plan (WSWMP).

The WARR Act aims to encourage efficient use of resources, reduce environmental harm, and reduce waste generation in accordance with the principles of ecologically sustainable development. To meet the objectives of the Act, waste management options must be considered and selected in accordance with the following hierarchy:

- Avoidance of unnecessary resource consumption in the first instance.
- Recovery of resources and reduction of waste volumes through re-use and recycling practices.
- Disposal of wastes as a last resort.

The WSWMP is a waste management project that aims to identify achievable waste management methodologies for the councils in the Western Region. The WSWMP adopts the waste management hierarchy of the WARR Act, giving preference to avoiding waste generation in the first instance and re-use and recycling of materials where waste generation cannot be avoided. The main objectives of the plan are to provide direction for the ongoing management of waste services and collaborative interaction opportunities for participating councils, which include Broken Hill City Council.

12.6.3. Potential impacts

Construction

Construction of the project has the potential to produce the following wastes:

- Excess spoil.
- Vegetation from removal of shrubs and trees.
- Packaging materials associated with items delivered to site, such as pallets, crates, cartons, plastics and wrapping materials.
- Wastes produced from the maintenance of construction equipment and machinery, including liquid wastes from cleaning, repairing and maintenance.
- Sewage wastes generated through the use of worker's facilities such as toilets. During construction, portable toilets would be used to provide onsite toilet facilities. These would be serviced weekly and waste would be disposed of offsite at a processing location.

- General office and domestic wastes, such as paper and food wastes.

The volumes of waste generated during construction are anticipated to be small and would not present any waste management or disposal issues. To minimise the amount of excess spoil, the detailed design of the project would aim to achieve a cut/fill balance. Where possible, green waste would be mulched for re-use on site as part of the landscaping works and/or 'wind-rowed' along the edges of the transmission line easement. Minimisation of packaging materials would be strongly encouraged and used packaging materials would be recycled or reused where possible.

Operation

Small quantities of waste may be produced intermittently during operational maintenance activities. This waste would be limited to small volumes of green waste from selective pruning along the transmission line easement and general domestic waste. Any green waste generated would be disposed of on the ground within the transmission line easement. Operation of the project would have little or no impact on waste disposal resources in the region.

12.6.4. Impact mitigation and management measures

Construction

- All works would be conducted in accordance with the waste management hierarchy established by the WARR Act, that is:
  - Unnecessary resource consumption would be avoided to the greatest extent practicable.
  - All waste or redundant materials generated by the project would be re-used or recycled where feasible and reasonable.
  - Waste disposal to land fill would only be carried out as a last resort when re-use or recycling is not a feasible and reasonable alternative.
- Excavated spoil would be re-used on the project site for fill or landscaping, where possible.
- Native vegetation cleared for the project would be used in site restoration and landscaping or 'wind-rowed' along the edges of the transmission line easement, where possible.
- Any excess re-usable and recyclable materials that cannot be re-used or recycled on the project site (such as any excess spoil or greenwaste) would be transported to an appropriate, licensed recycling facility or to an appropriate area for re-use.
- Any excess materials that are not re-usable or recyclable would be disposed of at the Broken Hill City Council Waste Depot.
- Transport of wastes to recycling or waste disposal facilities would be undertaken by an appropriately licensed waste transporter.
- Any waste oils, greases and chemicals generated during the construction phase would be stored in appropriately bunded areas prior to their removal for recycling or disposal.

- Any soils contaminated through fuel or chemical spills would be excavated and transported to a licensed waste facility and the resulting excavations would be filled with suitable clean soil.
- Any weed species that are cleared for the project would be collected in plastic bags and disposed of at a licensed green waste disposal facility or landfill.
- General wastes would be segregated into recyclable and non-recyclable streams through the provision of appropriate disposal bins on the project construction site. These materials would be transported off-site to an appropriate facility when the bins reach 80 per cent capacity.

Operation

Operation of the project is not anticipated to generate any significant waste volumes or any hazardous waste materials. As such, no specific waste management measures are required for the operational phase of the project. Operation of the project would be carried out in accordance with AGL's environmental policies and procedures.

13. Draft Statement of Commitments

This chapter provides AGL's draft Statement of Commitments (SoC) for the project in relation to environmental impact mitigation, management and monitoring.

The Director-General's Requirements

The Environmental Assessment must include a draft Statement of Commitments detailing measures for environmental mitigation, management and monitoring for the project.

13.1. Overview

This Environmental Assessment recommends a range of measures to avoid, manage, mitigate, and/or monitor the construction and operational impacts of the project. These measures have informed the development of the draft SoC for the project, which is presented in **Table 13-1**. The draft SoC aims to specify what environmental objectives would be achieved.

The SoC will be finalised in response to stakeholder and community input during the display of this Environmental Assessment. The final SoC would be considered by DoPI in assessing the project. Should approval be granted by the Minister for Planning, the final SoC may inform the Conditions of Approval.

Following project approval, the finalised SoC would guide subsequent phases of the proposed development. It is intended that the contractor selected to undertake planning, design, construction and/or operation of the project would be required to undertake all works in accordance with the final SoC and the Conditions of Approval.

Table 13-1 Draft Statement of Commitments

Objective	Reference	Commitment	Project phase
Environmental management			
Compliance and continuous improvement in environmental management	EM1	The head contractor for the project will have an accredited environmental management system, including a performance and compliance auditing program.	Construction
Minimise impact of construction on surrounding area	EM2	A construction environmental management plan (CEMP) would be prepared and implemented before the start of any construction activities.	Pre-construction & construction
Community consultation			
Stakeholders and the community are kept well informed about the project	CC1	A community consultation plan would be prepared and implemented. The plan would include a phone line, project e-mail and website for community input, a complaints handling procedure, and procedures for targeted consultation with affected stakeholders.	Pre-construction & construction
Visual impacts			
Minimise potential for adverse visual impacts during construction	V1	Vegetation removal would be avoided as far as practicable during construction. Any native vegetation near the outside edge of the solar PV plant site boundary would be cordoned off to minimise the risk of accidental disturbance.	Construction
	V2	Vehicles would remain on designated paths during construction to avoid degradation of the landscape.	Construction
	V3	Construction equipment and infrastructure would be demobilised from site as soon as practicable and all unnecessary project flagging and signage would be removed and disposed of at the completion of construction.	Construction
Minimise long-term visual impacts on the landscape	V4	Plantings of locally indigenous, shrubby vegetation would be provided along the north eastern and part of the north western boundary of the solar PV plant site to mitigate the visual impacts on views to The Pinnacles from the Barrier Highway, Silverton Road and Magazine Way. Plant species would be selected to be of optimum height so as not to block views of The Pinnacles.	Pre-construction, construction & operation
	V5	Access tracks would be constructed of locally sourced gravel (to the extent required) that matches the colour of the existing site surface as far as practicable.	Construction & operation

Objective	Reference	Commitment	Project phase
	V6	Underground cabling would be used where practical. The colour of above-ground ancillary electrical equipment associated with the solar PV plant would be selected to best integrate with the surrounding landscape, with preference given to earthy tones such as pale green and pale brown.	Pre-construction, construction & operation
Minimise potential glare impacts	V7	Any glare impacts would be ameliorated through roadside planting.	Pre-construction, construction & operation
Noise impacts			
Minimise potential construction noise impacts on sensitive receivers	N1	Although construction noise impacts are unlikely, identified sensitive receivers in the vicinity of the project site are to be given adequate prior notice of the construction program, kept informed throughout the construction period, and provided with a name and contact number for construction noise information and complaints. Any noise complaints will be dealt with through the standard complaints management procedure identified in the community consultation plan.	Pre-construction & construction
	N2	Construction noise and vibration would be minimised as far as practical through the implementation of all feasible and reasonable measures. These measures would be confirmed during detailed design and specified within a Construction Noise and Vibration Management Plan (CNVMP). The CNVMP would also include project-specific objectives and protocols for management of construction noise.	Construction
	N3	Construction activities would take place during standard working hours (7.00am to 6.00pm Monday to Friday, 8.00am to 1.00pm Saturday and no work on Sunday or public holidays). Any work outside of these hours would be undertaken in accordance with the ICNG. The CNVMP will specify protocols for approval from Broken Hill Council and notification of potentially affected receivers for out-of-hours work.	Construction
	N4	Where feasible and reasonable, restrictions may be placed on the timing of noisy construction activities. These restrictions may include requirements for respite periods and/or the scheduling of noisy activities in consultation with sensitive receivers.	Construction
	N5	Construction plant, equipment and methodologies would be selected in consideration of the need to minimise noise levels where feasible and reasonable.	Construction

Objective	Reference	Commitment	Project phase
Flora and fauna			
Minimise clearing of native vegetation and habitat	FF1	The amount of native vegetation clearing would be restricted to the minimum area necessary for construction. Clearing boundaries would be specified within construction environmental management plans and delineated on site with appropriate boundary or exclusion fencing to prevent unnecessary damage or clearing of vegetation and habitat.	Pre-construction & construction
Minimise potential impacts on fauna during construction	FF2	Vehicle speed reduction measures would be installed along internal access roads to minimise the incidence of wildlife mortality from construction and operation vehicles.	Construction
	FF3	A 'no-go' buffer zone of 500 metres in radius would be placed around the Black-breasted Buzzard nest site should it still be present at time of construction. No construction vehicles or personnel would enter this 'no-go' area unless assessing the presence of this species.	Construction
	FF4	On site waste management practices would prevent attracting or encouraging feral animals to the site during the construction period.	Construction
Restore and revegetate the project site as far as practical to enhance its habitat value and prevent long term degradation	FF5	Degraded portions of the site outside of the impact footprint would be restored to: a) reduce the potential for wind erosion, b) improve opportunities for fauna habitation and movement across the landscape, and c) reduce the risk of weed invasion. These areas would include a) the site perimeter, b) areas that are not impacted by infrastructure and access road footprints, and c) areas that do not need to be kept clear of vegetation for maintenance purposes or safety.	Construction & operation
	FF6	Site restoration and revegetation activities will occur during construction and post-construction.	Construction & operation
	FF7	Appropriate weed management strategies would be implemented during construction and operation.	Construction & operation
	FF8	An Offset Strategy would be developed, including an Offset Management and Rehabilitation Plan.	Pre-construction
Aboriginal heritage			
Manage impacts on known Aboriginal artefacts recorded within the project site	IH1	Management of the 14 Aboriginal heritage sites recorded during the survey of this environmental assessment is to be subject to further consultation with the Aboriginal stakeholders. Following this further consultation, an Aboriginal Heritage Management Plan would be developed to specify how the sites would be protected in-situ, relocated or salvaged.	Pre-construction & construction

Objective	Reference	Commitment	Project phase
Minimise impacts on any previously unidentified Aboriginal heritage sites and objects	IH2	Protocols developed for the project will facilitate appropriate protection and management of any previously unidentified Aboriginal artefacts or objects or suspected human remains found during construction. The protocols may, as required, include stopping all works in the vicinity of the find, notification of relevant stakeholders and implementation of an appropriate management strategy.	Pre-construction & construction
	IH3	All construction personnel will receive training in the management of Aboriginal artefacts and objects, including legal obligations, the application of protocols, and the recognition of artefacts.	Pre-construction & construction
Traffic and transport			
Provide safe access to the project site from the Barrier Highway	TT1	The existing site access road off the Barrier Highway and the associated intersection would be upgraded in accordance with RMS standards to accommodate construction traffic and on-going maintenance access.	Design
Minimise impacts on users of local roads and the Barrier Highway during construction	TT2	A Construction Traffic Management Plan would be prepared and implemented for the construction phase of the project. The plan would specify the: ■ Travel routes and parking areas for construction traffic, including all temporary turning and access arrangements. ■ Speed limits and directions of travel on the access roads within the construction site. ■ Timing of deliveries. ■ Traffic control requirements, including requirements for signage, barriers, traffic control personnel.	Pre-construction & construction
Manage and rectify any impacts on road infrastructure	TT3	A road condition survey would be undertaken before construction to determine the potential impacts on the structural integrity of road infrastructure, including bridges and intersections. A Construction Stage Roads Management and Maintenance Plan would then be prepared by AGL and its construction contractor in consultation with Broken Hill City Council and the RMS. This plan would set out the requirements for road management, monitoring and maintenance.	Pre-construction & construction
Hazards and risks			
Minimise risk of exposure to EMFs	HR1	The proposed transmission line route has been selected to avoid EMF impacts on sensitive receivers.	Design
Minimise bushfire risks	HR2	The NSW Rural Fire Service and Broken Hill Council would be consulted to verify the presence of any bushfire prone areas. An appropriate Asset Protection Zone would be maintained around the solar PV plant and transmission line.	Construction & operation

Objective	Reference	Commitment	Project phase
Minimise risks associated with use and storage of chemicals during construction	HR3	Any dangerous goods or hazardous materials stored on the construction site would be stored in a securely bunded area of sufficient containment capacity.	Construction
	HR4	Where dangerous goods or hazardous materials are to be stored on the construction site, an effective spill kit would be available for use at all times. Any accidental spills would be contained and cleaned up immediately.	Construction
	HR5	Major plant and equipment would be re-fuelled either off site or by a mobile mini-fuel tanker with a spill procedure and spill kit.	Construction
	HR6	Transport of dangerous goods or hazardous materials would be undertaken by an appropriately licensed contractor.	Construction
	HR7	A number of site-specific plans would be prepared and implemented for the project, including an incident management plan. This plan would identify the potential incidents that may occur during construction and the corresponding incident response procedures.	Pre-construction & construction
Water management (water supply, water quality and waterways)			
Minimise potential for soil erosion and off-site transport of eroded sediments to waterways	WM1	Appropriate erosion and sediment control measures, consistent with the guidelines of the 'Blue Book' (Landcom, 2006), would be established before any clearing, excavation or ground disturbance begins and maintained in effective working order until the works have been completed and the affected ground surfaces stabilised.	Pre-construction & construction
	WM2	The area of soil exposure/ disturbance would be kept to the minimum amount necessary.	Construction
	WM3	Stockpiles of spoil, fill or erodible material would not be placed in or near watercourses or drainage lines.	Construction
	WM4	Construction traffic would be confined to existing established roads and access tracks. During construction, the site access junction with the Barrier Highway would be monitored for any build up or deposition of soil or debris. Any soil or debris tracked onto the road would be removed at the end of each work day and disposed of appropriately.	Construction

Objective	Reference	Commitment	Project phase
	WM5	Disturbed surfaces would be stabilised and restored as soon as possible using appropriate stabilisation and revegetation measures. Stabilisation and restoration of disturbed areas would take place in a progressive manner during construction, where practicable. The plants used for site restoration would comprise native species endemic to the project site and suitable for the site conditions, taking into account soils, climate and the shaded area under the solar PV plant panels.	Construction
Minimise risks associated with use of chemicals during construction	WM6	To avoid accidental contamination of receiving waterways with chemicals or fuels, the commitments identified for *Hazards and risks* (above) would be adhered to.	Construction
Land use			
Minimise general land use impacts	L1	Landowners or leaseholders would be informed of the construction schedule and scope of works prior to construction.	Pre-construction
	L2	Where the project affects Crown land, the NSW DPI and the affected leaseholder would be consulted on the arrangements for transfer or alteration of the lease.	Pre-construction
	L3	Easements and associated land use restrictions would be identified on property titles.	Pre-construction
	L4	Access to properties surrounding the construction site would not be impeded by construction activities.	Construction
Minimise impacts on future mining exploration	L5	Consultation would occur with current mining exploration and extraction licence and lease holders.	Pre-construction
Non-Indigenous heritage			
Minimise impacts on any previously unidentified non-Indigenous heritage items	H1	Protocols developed for the project will facilitate appropriate protection and management of any previously unidentified relics or suspected human remains found during construction. The protocols may, as required, include stopping all works in the vicinity of the find, notification of relevant stakeholders and implementation of an appropriate management strategy.	Pre-construction & construction
	H2	All construction personnel will receive training in the management of non-Indigenous relics, including legal obligations, the application of protocols, and the recognition of relics.	Pre-construction & construction

Objective	Reference	Commitment	Project phase
Socio-economic issues			
Minimise potential impacts on the Broken Hill community	S1	Advance notification would be given to the local community of Broken Hill (including any potentially affected property owners and occupants) on the construction schedule, construction works and access arrangements.	Pre-construction & construction
Geology and soils			
Minimise potential for soil erosion	GS1	The commitments identified for *Water management* above would address the risks of soil erosion. No additional actions are required for geology and soils.	Pre-construction & construction
Air quality and climate			
Minimise dust generation	AQ1	Construction areas would be monitored for dust generation and appropriate dust suppression measures implemented in a timely manner, as required.	Construction
	AQ2	The access road connecting the Barrier Highway to the project site would be constructed with packed gravel as required to minimise dust and soil impacts.	Construction
	AQ3	Areas of soil disturbance would be stabilised in a progressive manner as soon as practical.	Construction
	AQ4	Construction vehicles/machinery would not be left running or idling when not in use.	Construction
	AQ5	Construction plant would be fitted with appropriate emission controls and would undergo periodic and regular maintenance to reduce exhaust emissions.	Construction
	AQ6	Vehicular loads of spoil and other erodible material would be suitably covered during transport.	Construction
	AQ7	No burning of vegetation or waste material would take place on the construction site.	Construction
Waste management			
Minimise waste generation and disposal	W1	All works would be conducted in accordance with the waste management hierarchy established by the WARR Act.	Construction
	W2	Excavated spoil would be re-used on the project site for fill or landscaping, where possible.	Construction
	W3	Native vegetation cleared for the project would be used in site restoration and landscaping or 'wind-rowed' along the edges of the transmission line easement, where possible.	Construction

Objective	Reference	Commitment	Project phase
Ensure appropriate disposal of wastes	W4	Any excess re-usable and recyclable materials that cannot be re-used or recycled on the project site (such as any excess spoil or greenwaste) would be transported to an appropriate, licensed recycling facility or to an appropriate area for re-use.	Construction
	W5	Any excess materials that are not re-usable or recyclable would be disposed of at the Broken Hill City Council Waste Depot.	Construction
	W6	Transport of wastes to recycling or waste disposal facilities would be undertaken by an appropriately licensed waste transporter.	Construction
	W7	Any waste oils, greases and chemicals generated during the construction phase would be stored in appropriately bunded areas prior to their removal for recycling or disposal.	Construction
	W8	Any soils contaminated through fuel or chemical spills would be excavated and transported to a licensed waste facility and the resulting excavations would be filled with suitable clean soil.	Construction
	W9	Any weed species that are cleared for the project would be collected in plastic bags and disposed of at a licensed green waste disposal facility or landfill.	Construction
	W10	General wastes would be segregated into recyclable and non-recyclable streams through the provision of appropriate bins on the construction site. These wastes would be transported to an appropriate facility when the bins reach 80 per cent capacity.	Construction

13.2. Environmental Management

Following approval of the project, the project requirements for environmental impact mitigation, management and monitoring would be set out within construction and operational environmental management plans (EMPs). These plans would address both the final SoC and the Conditions of Approval for the project. The plans would identify:

- Approval conditions and statutory requirements.
- Environmental objectives and environmental performance requirements.
- Details of specific procedures, timing and responsibilities for implementing the required impact mitigation, management and monitoring measures.
- Clear guidelines for emergency response and incident management.

13.3. Environmental Reporting

Periodic environmental reports would be prepared to measure performance and progress against the EMPs. These reports would provide relevant authorities with access to important environmental information about the project. Any shortcomings in environmental performance identified by the reporting process would be addressed by updating the relevant EMP.

13.4. Emergency Response

An emergency response and incident management plan (ERIMP) would be prepared to ensure incidents are handled promptly and safely. The ERIMP would outline the appropriate emergency response equipment that would be provided, the mandatory training requirements, the emergency response procedures and the responsibilities of site operators for these matters.

14. Project Justification and Conclusion

This chapter summarises the conclusions of this environmental assessment and outlines why the project should proceed. In justifying why the project should proceed, consideration has been given to its environmental, social and economic impacts, the suitability of the proposed development site and the public interest. This chapter also addresses the principles of ecologically sustainable development.

The Director-General's Requirements

The Environmental Assessment must include a conclusion justifying the project taking into consideration the environmental, social and economic impacts of the project; the suitability of the site; and the public interest.

14.1. Site Suitability

The proposed Broken Hill Solar Plant would be located in far western NSW, approximately five kilometres south-west of the city of Broken Hill. The proposed site is considered an ideal location for the PV project based on:

- A high solar production potential, which is further enhanced by the site's flat terrain.
- Good access to the electrical grid.
- Sufficient area of suitable land.

Additionally, the proposed site has been selected to minimise potential negative impacts to the Broken Hill community and the environment. The site is not located within a sensitive environment or in close proximity to sensitive receivers. With the implementation of the impact mitigation and management measures identified in this environmental assessment, the project would have no significant or long-term adverse effects.

14.2. Summary of Project Benefits

14.2.1. Environmental benefits

The project would provide a clean and sustainable means of electricity generation and would contribute to the Australian Government's Renewable Energy Target of sourcing 20 per cent of energy from renewable sources by 2020. The amount of electricity generated by the project would reduce greenhouse gas emissions by approximately 140,000 tonnes of CO_2e per annum, assuming a rate of 1.15 tonnes per MWh of electricity, compared with generating the same amount of electricity using coal or gas. Emissions of particulates and heavy metals and consumption of water would also be reduced in comparison to coal and gas technologies.

14.2.2. Social and economic benefits

The project would contribute significantly to job creation and economic development in regional NSW. AGL would aim to maximise local and regional content in plant procurement and construction through local sourcing of jobs and materials. Up to 197 local construction jobs would be created during the construction period (See **Table 12-3**). Additional jobs would also be created in the hospitality and retail industries in response to the need to accommodate and serve the construction workforce.

The creation of construction and service jobs would have a significant flow-on effect in the local communities, as a large proportion of the wages paid to the construction workforce and the service workers would be spent locally. It is estimated that $40 million would be spent in the local and regional community during construction of the project. Regional construction Gross Value Added (GVA) is estimated to be approximately $26.36 million. This GVA would add some 1.86% to the Broken Hill GRP and some 1.7% to the Far West NSW GRP (SKM, 2012).

Up to four new permanent local jobs would be created to support ongoing operation and maintenance of the project over a 30 year period. The gross regional product (GRP) for the project is estimated to be $1,417,922,806 for Broken Hill, adding approximately 1.86% to the Broken Hill GRP (SKM, 2012).

Construction of the project would provide training to local workers in solar PV plant development and construction, high voltage power system construction, and construction management/support. The solar energy industry is growing, and trained workers would support the growth of local and regional companies providing solar energy services. Trained workers would be able to find jobs supporting power plant development and construction long after the project has been completed.

The Broken Hill Solar Plant project would raise the profile of Broken Hill and regional NSW, and may generate interest and tourism in the region. The city of Broken Hill may be able to promote itself as a renewable energy hub which may stimulate further renewable energy investment in the region.

14.2.3. Industry development

The project would contribute significantly to the growth of the solar industry in regional NSW by transferring skills and experience to the local labour pool. Plant construction would engage a broad range of participants about solar resource, grid impacts, solar plant construction methods, local planning issues and community acceptance. The Broken Hill Solar Plant project represents a sustainable development and construction model that would promote the ongoing development of replicable large-scale power plants in Australia. Experience gained from this project would be used by AGL to develop, own and operate large-scale solar generation facilities.

14.3. Assessment of Environmental Issues

This environmental assessment has addressed the Director-General's requirements (DGRs). The detailed studies carried out as part of this environmental assessment have demonstrated that the construction and operation of the project can occur without significant environmental impacts. A summary of the potential impacts in relation to the key environmental issues identified in the DGRs is provided in **Table 14-1**.

Table 14-1 Summary of potential impacts for key environmental issues

Environmental issue	Summary of potential impacts
Visual impacts	Visual impacts would generally be low to negligible. The only area of potentially high impact is along the Barrier Highway near the north-eastern corner of the solar PV plant site where the solar PV plant would impact views south west to 'The Pinnacles'. This impact may be mitigated plantings along the boundaries of the site. There is a remote possibility of glare impacts on some sections of the Barrier Highway during early morning and late afternoon, although these impacts are expected to be minor. The transmission lines would have very low visual impacts, especially for locations more than 1 - 2km distant.
Noise impacts	The noise impacts of the project would be negligible. Construction noise is predicted to comply with the Interim Construction Noise Guidelines and is unlikely to have a significant impact on any sensitive receivers. Project operation would not generate any significant noise. Operational noise would be limited to occasional maintenance activities with very low noise emissions. The increase in vehicles on the Barrier Highway as a result of construction traffic would be very small relative to existing traffic volumes and is unlikely to have a measurable impact on traffic noise. Similarly, traffic noise during operation would be limited to four vehicles per day and would have no measurable impact. Given the distance between the project site and the nearest residential receiver, there would be no vibration impacts during either construction or operation.
Flora and fauna	The project would remove approximately 149.3 ha of native shrubland vegetation, and this would not affect any threatened flora species, populations or ecological communities. While the project site contains suitable habitat for three threatened bird species, the project is unlikely to impose a significant impact on local populations of any threatened fauna species or their habitats given the relatively small scale of the habitat disturbance involved and the presence of similar habitats in the surrounding landscape. The project would not significantly reduce the area of habitat occurring in the surrounding landscape or the wider bioregion, or have a significant impact on habitat connectivity. However, it is considered that the project will contribute to the potential cumulative loss of habitat in the region in the longer term. No nationally threatened flora or fauna species were identified on the project site and no such species are expected to occur.
Aboriginal heritage	Fourteen Aboriginal heritage sites were recorded within or close to the project impact footprint. Twelve of these sites are located within the project footprint and are likely to be affected during project construction. Management of these sites would be carried out through an Aboriginal Heritage Management Plan. The Aboriginal Heritage Management Plan would be developed to specify how the sites would be protected in-situ, re-located or salvaged.
Traffic and transport	The project would not have a significant impact on traffic or transport. Transport of construction staff, materials and equipment to/from the project site would be along the Barrier Highway. The resultant increase in traffic volumes on the highway is anticipated to be approximately 132 movements per day. This would be very minor and would be unlikely to have a significant effect on traffic flows or disrupt any public or private access routes. The existing private access road from the Barrier

Environmental issue	Summary of potential impacts
	Highway to the project site is sufficiently wide to accommodate the proposed construction traffic and widening of the road is not required. The road surface will be upgraded with compacted gravel as part of initial site works. The intersection of the access road with the Barrier Highway will be upgraded as required based on consultation with RMS. A detailed Traffic Assessment followed by a Traffic Management Plan will be prepared once traffic volumes and routes are confirmed by the appointed construction contractor/s and supplier/s. Once operational, daily traffic to the plant would be reduced to approximately four vehicle movements per day along the Barrier Highway and site access road. This volume of operational traffic would have a negligible impact on traffic and transport.
Hazards and risk	Hazards and risks associated with the project include electric and magnetic fields (EMFs), bushfire risks, potential impacts on aircraft, and the use of hazardous materials during construction. These hazards and risks have been examined and do not present a significant threat to human health or the environment. The alignment of the transmission line has been selected to avoid human exposure to EMFs. The bushfire and hazardous material risks during construction are typical of construction projects and can be adequately mitigated using standard environmental management practices. The bushfire risks associated with operation would be very minor as the solar PV plant would not be a source of heat or ignition, and the transmission line easement would be managed to prevent vegetation coming into contact with the conductors. Hazardous materials would not be permanently stored or routinely used on the site. The proposed transmission line poles are not high enough to affect any low-flying aircraft. Potential glare impacts from the solar PV plant are not likely to be an issue for aviation.
Water supply, water quality and waterways	The project does not involve use of water during operation and is therefore unlikely to affect the local water supply. Small volumes of water will be required for dust suppression during construction and this will be sourced from Essential Water, the responsible water supply authority in Broken Hill. AGL will consult with Essential Water to ensure sufficient water (up to 200 kL/day) is available for construction purposes and sufficient water for domestic purposes (to service up to two people per day) is available for operations. The project is unlikely to affect groundwater or salinity given that it does not involve deep excavation, other activities that could result in interception of groundwater, or other activities (such as irrigation), that could impact the water table. The project would not divert or alter any water courses, disturb the bed or banks of any waterways, or involve any discharges to waterways. The risks of accidental water pollution through chemical spills or off site transport of eroded sediment during construction would be minimised as far as practicable with the use of standard environmental management measures. The project is not located on a floodplain or within a flood prone area. The infrastructure associated with the project would be unlikely to obstruct any overland flood flows or significantly alter flood behaviour.

14.4. Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) is defined in the National Strategy for ESD as "…using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased". Achievement of ESD is underpinned by four principles:

- The precautionary principle.
- Inter-generational equity.
- Conservation of biological diversity and ecological integrity.

- Improved valuation, pricing and incentive mechanisms.

The following sections detail the four principals of ESD and how they have been addressed in the planning and assessment of the project.

14.4.1. Precautionary principle

The precautionary principle deals with uncertainty in decision-making. It provides that, where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

The potential environmental consequences of the project have been assessed to the fullest extent possible as part of the environmental assessment process. This process included specialist studies in relevant disciplines and has been based on accepted assessment methodologies. This has enabled the potential impacts of the project to be predicted with an adequate degree of scientific certainty.

The threat of serious or irreversible environmental damage is a necessary pre-condition for the application of the precautionary principle. As such, based on the results of this environmental assessment, the precautionary principle does not strictly apply to the project. The potential impacts of the project are minor and would not lead to any significant or long-term adverse effects. Nevertheless, a precautionary approach has been adopted and a range of impact mitigation, management and monitoring measures have been proposed within this environmental assessment. These measures would be implemented in conjunction with the project to minimise any risks and adverse effects as far as practicable.

The project itself represents a proactive step to reduce the impacts associated with electricity generation, in particular the generation of greenhouse gas emissions.

14.4.2. Inter-generational equity

The principle of inter-generational equity concerns the need to maintain or enhance the health, diversity and productivity of the environment for the benefit of future generations. The project is consistent with this principle in that it would provide a cleaner, more sustainable means of electricity generation (when compared to conventional power generation technologies such as coal and gas-fired power stations) in a manner that would have no significant or long-term adverse effects on the environment or community.

14.4.3. Conservation of biological diversity and ecological integrity

This principle requires that the conservation of biological diversity and ecological integrity is a fundamental consideration of any project. This principle has been considered in both the selection of the proposed project site and in the assessment of ecological impacts for the preferred site, as identified in this environmental assessment.

The project would be unlikely to impact any threatened species populations or ecological communities. The ecological impacts of the project would be minor and would be minimised as far as practicable with the implementation of the impact mitigation, management and monitoring measures proposed in this environmental assessment report.

14.4.4. Improved valuation, pricing and incentive mechanisms

The principle of improved valuation, pricing and incentive mechanisms requires that environmental factors are included in the valuation of assets and services. Approaches to improved valuation that are based on this principle include the following:

- Those who generate pollution and waste should bear the cost of containment, avoidance or abatement (polluter pays).
- The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.
- Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

AGL recognises the value of environmental resources and aims to minimise the impacts of its activities and operations by conducting thorough assessments of its activities and implementing appropriate impact mitigation measures. The value placed on the environment by AGL Energy is evident in the development of project design features and also in the extent of environmental investigations and proposed impact mitigation measures.

14.4.5. Summary of ESD considerations

Assessment of the project against the principles of ESD has provided a framework for:

- Recognising, describing and assessing the effects of construction and operation on environmental resources.
- Avoiding irreversible and detrimental damage to ecological resources.
- Maintaining and enhancing the health and quality of the environment for the benefit of present and future generations.
- Minimising the potential adverse impacts of the project as far as practicable.

In preparing this environmental assessment, the potential environmental impacts of the project have been investigated and a range of impact mitigation, management and monitoring measures identified. The impact mitigation and management requirements identified in this environmental assessment are based on the principles of ESD.

The principles of ESD will be further considered during the detailed design phase of the project and in the development of construction and operational environmental management plans.

14.5. Conclusion

The proposed Broken Hill Solar Plant represents a major investment by AGL for the development of large scale, grid-connected, solar power. The choice of site for the project was based on its high solar production potential and ease of access to the existing electrical grid. The site is also located on relatively flat terrain and away from environmentally sensitive areas. The use of the selected site for the proposed project is compatible with existing and future land uses in the area and would not sterilise or affect future land use potential.

The key environmental issues for the project have been considered in this environmental assessment. With the implementation of the impact mitigation and management measures identified in this report, the adverse impacts of the project would be minor and would be outweighed by the overall project benefits.

A draft Statement of Commitments (SoC) has been included in this environmental assessment. This SoC represents AGL's commitment to impact mitigation and management during construction and operation of the project.

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