

AGL

Broken Hill Solar Plant

ENVIRONMENTAL ASSESSMENT

Volume 7 – Appendix F to Appendix H

October 2012

SINCLAIR KNIGHT MERZ

Appendix F Aboriginal Heritage Assessment

The mixed, low chenopod shrubland that dominates the survey area (Image, M. Cotter).

Aboriginal Archaeological Assessment

Proposed Solar Project in Broken Hill

Broken Hill Local Government Area

Date: August 2012

Report Prepared by

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for Sinclair Knight Merz

on behalf of

AGL Energy

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Executive Summary

This archaeological assessment was commissioned by Sinclair Knight Mertz on behalf of AGL Energy (the Proponent). AGL Energy proposes to construct a Solar Project south-west of Broken Hill in far west NSW within the Broken Hill Local Government Area (LGA). This report has been prepared to meet the statutory requirements under Part 3A (Critical Infrastructure) of the NSW Environmental Planning and Assessment Act, 1979.

The Project Site is located approximately 5km south-west of Broken Hill, within the unincorporated area which is administered by the NSW Department of Lands, Western Division, and comprises rural land. The project site is located between the Barrier Highway to the north and the Peterborough Broken Hill railway line to the south, wholly within Lot 6806 Plan 823918 (Land and Property Management Authority) (CROWN). This site is approximately 200 ha in area. A 22kV electricity transmission line will be installed to connect the project to the existing Broken Hill substation. The power line will head east from the project for approximately 1.4 km before turning south along the alignment of the proposed 220kV power line from the Silverton Wind Farm. The 22kV transmission line will cross the rail line before connecting into the Broken Hill substation (**Figures 1-2).**

Archaeological survey was conducted over two field trips comprising four days in total. Accompanying OzArk for both field trips were Dulcie and Raelene O'Donnell of the Broken Hill Local Aboriginal Land Council (BHLALC). In total fourteen (14) Aboriginal archaeological sites[1] were recorded, with thirteen (13) located within the main survey area and one (1) situated within to the transmission line easement in the adjoining crown reserve to the east of the main survey area.

The primary issues in terms of Project impacts will be from the following:

- Construction works within the Project Site. Impacts are to occur across the area encompassed by the green line in **Figure 7**. This will impact eleven Aboriginal sites (BHS1-9 and 13-14).
- The ETL construction is likely to impact one Aboriginal site. This impact could be ameliorated by pole placement and access to the ETL being controlled in relation to the artefacts of site BHS-11.

Site-specific impacts are summarised in **Table 11.**

Management of these sites has been the subject of consultation with the Aboriginal community through distribution of this report to the registered stakeholders. Following project approval the management recommendations, as documented in this report, will be required to become part of an Aboriginal Heritage Management Plan (AHMP) which will be developed in consultation with the registered stakeholders.

The basis for site management in the AHMP should be as follows:

1. Fourteen (14) Indigenous sites were recorded during the heritage survey (BHS-1 to BHS-14). All are located within or in close proximity to the Project Site. Management of these sites should be the subject of further consultation with the Aboriginal community stakeholders for this project

[1] Site boundaries are frequently arbitrarily determined (Burke & Smith, 2004). For this survey, on ground perception that two Aboriginal objects were greater than 25m apart resulted in them being determined to be separate 'sites'.

through the formulation of an Aboriginal Heritage Management Plan (AHMP), should Project Approval be received.

2. The basis for site management in the AHMP should be as follows:

    a. Sites BHS-4-9 and 14 are located within the Impact Footprint for the photovoltaic units. These seven sites are predominantly isolated finds, with one small artefact scatter. The management of these objects is best undertaken through collecting them and moving them out of harm's way or facilitating the Broken Hill LALC to have Care and Control of these artefacts in perpetuity. The fate of the artefacts would need to be decided by the Aboriginal community through the development of the AHMP for the project, which would occur after the approval process is complete.

    b. Site BHS-11 is a deflating artefact scatter that may have some hearth /ground oven material in association. Management of the surface manifestations of this site in reference to the ETL construction should be undertaken as follows:

        i. In the company of a qualified Aboriginal sites officer or archaeologist, the Proponent should peg out the impact footprints of the ETL in the vicinity of the site.

        ii. If at all possible the ETL poles and access track should be sited so as to span the artefactual material.

        iii. If some surface artefacts cannot be avoided then collection / removal is the appropriate management.

    c. Sites BHS-1-3,10 and 11-12 are currently avoided by the project impacts. Care should be taken to ensure that changes to construction footprints do not endanger these sites into the future. Due to the proximity of the majority of these sites to the project impacts, the Proponent should ensure that they are fenced and that all staff and contractors are aware of the location of the site and its legislative protection under the NPW Act 1974.

3. The presence of Aboriginal cultural heritage sites significant to the local Aboriginal communities may be appropriately recognised via signage, designed and / or approved by the relevant stakeholders through AHMP process.

4. Should any other 'objects' or other Aboriginal sites be identified during the course of construction, work in that area should cease and the Traditional Owners / BHLALC / DECCW South Western Regional Office be contacted to discuss how to proceed.

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1 Introduction

1.1 Brief Description of the Project

This archaeological assessment was commissioned by Sinclair Knight and Mertz on behalf of AGL Energy (the Proponent). AGL Energy proposes to construct a Solar Project south-west of Broken Hill in far west NSW, within the Broken Hill Local Government Area (LGA)

This report has been prepared to meet the statutory requirements under Part 3A (Critical Infrastructure) of the NSW Environmental Planning and Assessment Act, 1979.

1.2 Location

The Project Site is located approximately 5km south-west of Broken Hill. The project is entirely within the unincorporated area which is administered by the NSW Department of Lands, Western Division, and comprises rural land.

The project site is located between the Barrier Highway to the north and the Peterborough Broken Hill railway line to the south, wholly within Lot 6806 Plan 823918 (Land and Property Management Authority) (CROWN). This site is approximately 200 ha in area. An Electricity Transmission Line will connect the Project Site to the nearby Broken Hill substation. The location of the project site and immediate surrounds is shown in Figure 1.

1.3 Date of Heritage Assessment

The field assessment for this project was undertaken over two field trips – the first comprising three consecutive days (24 to 26 November, 2010), and the second comprising one day, Thursday 24th March 2011.

This project was since halted with recommencement beginning in May 2012. At this stage, as the Project Area had been reduced, re-survey was not considered necessary, however some edits have been made to the report to reflect project changes.

1.4 Aboriginal Community Involvement

Consultation for this project was undertaken under the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (*ACHCRs*), however the first field assessment was conducted prior to stakeholders formally expressing interest in view of the requirement to instigate project surveys in a timely manner.

Stage 1 of the *ACHCRs* commenced on 17 November 2010, with letters sent to all relevant potential stakeholders seeking expressions of interest (EOIs) and with advertising in the Barrier Daily Truth on Nov 20, 2010 (See Appendix 1 for copies). Negotiations with Broken Hill Local Aboriginal Land Council (BHLALC) for the provision of a Site Officer also commenced concurrently, resulting in Ms Dulcie O'Donnell and Ms Raelene O'Donnell (trainee) representing BHLALC on all survey days.

Following the field assessment, EOIs were received from Mutawintji National Park Board of Management (Mutawintji NPBOM) and Mutawintji Local Aboriginal Land Council (Mutawintji LALC).

ACHCR Stage 2/3 letters presenting information about the proposed project and describing the proposed heritage assessment methodology were sent to all stakeholders with a request for any specific cultural information (should any be available), as well as inviting comment / input on the

methodology proposed. Patrick Laughton, a representative of both Mutawintji NPBOM and Mutawintji LALC, acknowledged receipt of the project details and advised it would be presented to the Board of both organisations. Although formal feedback was not received from Broken Hill LALC they provided two Site Officers to participate in the survey which followed the outlined methodology.

As this project was temporarily halted in 2011 (with letters sent top RAPs, see Appendix 1), the report was never then distributed to the Aboriginal community. As the project has been recently recommenced, the report has been revised slightly to reflect the minor project alterations in readiness for the final consultation phase.

A copy of the draft report was issued to registered stakeholders in 26th July 2012 and feedback was invited within the recommended twenty eight (28) day time frame. A log and copies of correspondence with Aboriginal community stakeholders is presented in **Appendix 1**. It is noteworthy that no comments were received from the Registered Aboriginal Parties.

1.5 Desktop Database Searches Undertaken

A desktop search was conducted on the following databases to identify any potential issues (**Table 1**):

Table 1: Desktop-database search results

Name of database searched	Date of search	Type of search	Comment
Australian Heritage Database http://www.environment.gov.au/heritage/ahdb/	7 June 2012	Broken Hill LGA.	No places on the search are within the Study Area
NSW Heritage Office State Heritage Register and State Heritage Inventory http://www.heritage.nsw.gov.au/	7 June 2012	Broken Hill LGA	No places on the search are within the Study Area
National Native Title Claims Search http://www.nntt.gov.au/Applications-And-Determinations/Search-Applications/Pages/Search.aspx	7 June 2012	Broken Hill LGA	One registered claim: Pooncarie Barkandji People #8 c/- NTSCORP Limited.
Department of Sustainability, Environment, Water, Population and Communities (SEWPC) Protected Matters (EPBC Act) Database; http://www.environment.gov.au/erin/ert/epbc/index.html	7 June 2012	Broken Hill LGA	None of the Aboriginal places on the AHD occur near the Study Area.
Department of Environment, Climate Change and Water (DECCW) Aboriginal Heritage Information Management System (AHIMS);	Frist search: Sinclair Knight Merz (2010) Second search : OzArk 7.6.2012	5 km radius of proposed works.: 3 x 4km area surrounding project Site	55 registrations within the original search area. None fall within the Study Area, however the closest sites are: - 23-4-0093: c. 475 m from the proposed PV plant / 680 m from ETL; and - 23-4-0085: c. 1.8 km from the proposed PV plant / 110 m from ETL.
Local Environment Plan	7 June 2012	Broken Hill LEP of 1996.	The Broken Hill LEP includes no Aboriginal heritage sites within the Study Area.

1.6 OzArk EHM Involvement

This assessment was undertaken by Dr Maria Cotter, Ms Pauline Hams and Dr Jodie Benton. Mr James Sutherland, Mr Kim Tuovinen, Dr Jodie Benton and Dr Cotter wrote and edited this report.

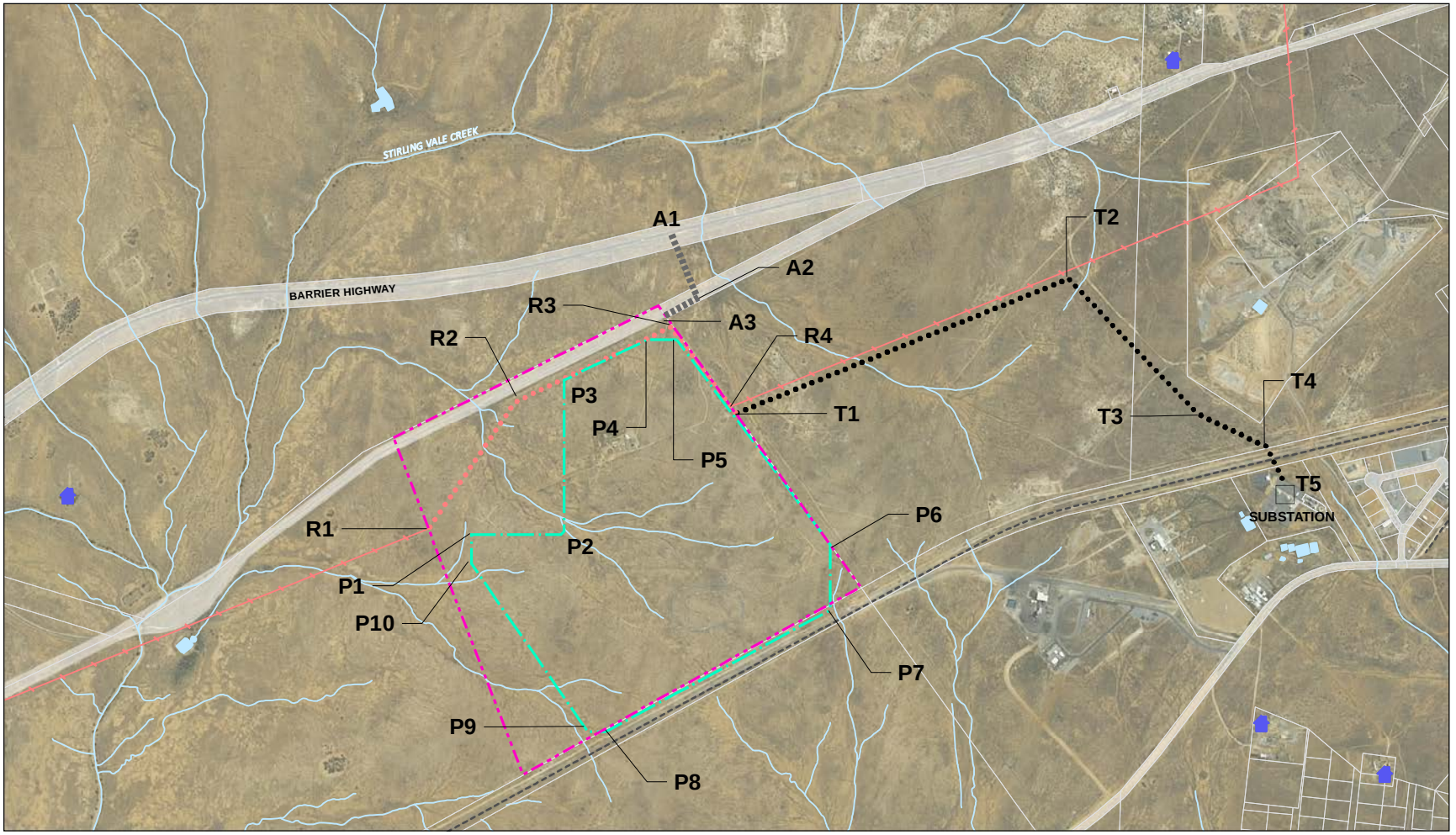

Figure 1 Site layout and location points

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Spatial Team - Prepared by : JC
Checked by : JL

2 The Project

The following information comes from the Sinclair Knight Merz Preliminary Environmental Assessment (PEA), 2010.

Under the Australian Governments Solar Flagships Program, AGL Energy proposes to seek approval for the construction and operation of a solar project (specifically a nominal 50 MW photovoltaic (PV) electricity generation project) south-west of the township of Broken Hill.

The solar project will connect into the national electricity grid at the TransGrid Broken Hill substation. Approximately 200 hectares of land would be required for a nominal 50 MW photovoltaic (PV) plant at Broken Hill. The site comprises a cleared, relatively flat area with numerous unsealed access tracks scattered throughout. Along with the PV arrays, the proposed development would also include the installation and operation of a double circuit 22 kV overhead line (OHL), approximately 2.7 km long, to connect the plant to the TransGrid Broken Hill substation. This OHL will be a pole route requiring a 30m wide easement adjacent to the existing easements as shown in figure 2.

The Broken Hill site was identified as the preferred location for the solar PV project based on the following:

- Availability of an abundant solar resource;
- Access to connect to the electricity grid;
- Availability of appropriate land; and
- Suitability in terms of the interests of other stakeholders and the environment.

2.1 Proposed Works

2.1.1 Layout

The project would comprise the installation of a nominal 50 MW PV plant with panel arrays. The project would comprise the following elements:

- A solar PV module (comprising 24 PV arrays) using the stable compound cadmium telluride (CdTe) as the semiconductor with a nominal capacity of 50 MW. Each solar array would be fixed at a 20° tilt.
- A new 22kV double circuit transmission line approximately 2.7 km long to connect the site to the Broken Hill substation.
- Aboveground and underground electrical conduits and cabling which connect the arrays to the inverters and transformers.
- A system of inverters, step up transformers and ring main units (RMUs) throughout the arrays.
- A marshalling switchgear to collect the power from the multiple array blocks.
- Internal access tracks to allow for maintenance of the site.
- Perimeter security fencing and landscaping around the site.
- Supervisory control and data acquisition (SCADA) control system.
- Site office and maintenance building.

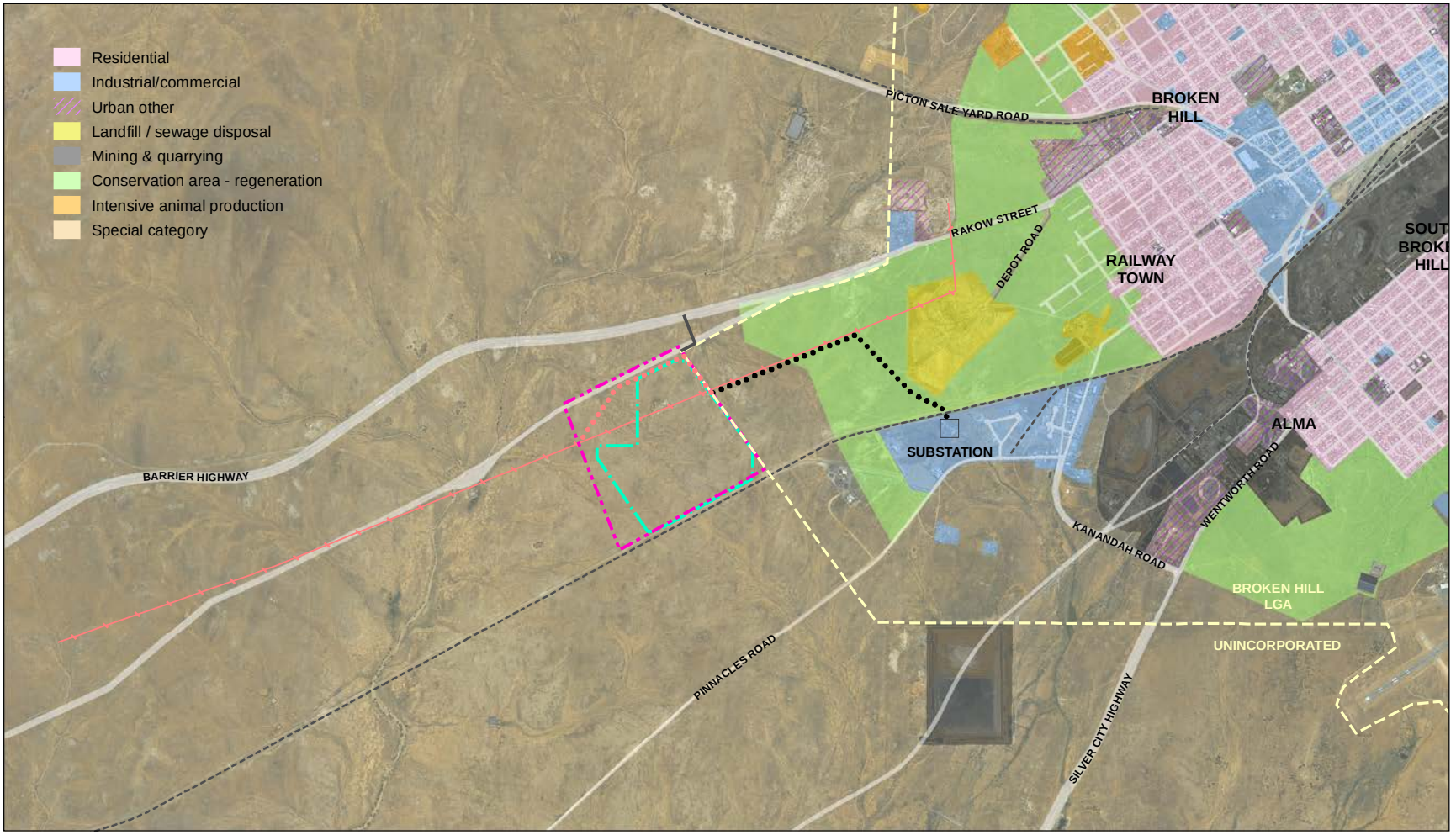

Figure 2 Location of proposed solar project and its surroundings

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Spatial Team - Prepared by : JC
Checked by : JL

- Temporary infrastructure associated with the site construction including site compound and storage areas.

2.1.2 Power Generation and Transmission

The following information comes from the Sinclair Knight Merz PEA, 2010. The solar panels (arrays) would be connected in series to form strings and then the strings connected together in parallel and fed into inverters. The inverters convert the DC power from the solar arrays into AC power (3 phase at 315 volts) which is then transformed into 22kV by the transformer. The 22kV collector system then brings all of the power together at the interconnection point where the 22kV double circuit then allows the export of this power to the existing Broken Hill substation. The location of the proposed 22 kV OHL is identified in Figure 2. The line will follow an existing 30 m wide easement which exits the proposed site in an easterly direction for approximately 1.4 km. The proposed line will then turn south, following the existing Silverton OHL easement for 1.3 km to the TransGrid substation.

2.1.3 Construction and operation

It is anticipated that during the construction period for the Broken Hill Solar PV project, approximately 150 construction personnel would be required on site. Plant operation would be largely automated and only minimal maintenance activities will be required. Approximately two to three jobs would be created to support ongoing plant operations and maintenance.

2.1.4 Project Construction Phase

The overall construction works for the Broken Hill Solar PV project is expected to take approximately 17 months. The main construction activities would include:

- Site establishment and preparation for construction (preliminary civil works and drainage),
- Piling of steel posts to provide support for the PV panels,
- Attachment of tilt brackets and rails which hold the PV panels,
- Connection of the PV panel modules to the brackets,
- Installation of the inverters,
- Trenching and wiring of underground cabling (DC and AC),
- Construction of the transmission and connection assets,
- Installation of PV switchgear, transformers and connection to transmission infrastructure,
- Commissioning and testing of the plant; and
- Removal of temporary construction facilities and completion of restoration works.

2.2 Heritage Assessment Methodology

OzArk Environmental & Heritage Management (OzArk) was briefed by the Proponent to undertake survey to assess the Aboriginal archaeological values of the Study Area, assess potential impacts of the Proposal to these values and recommend management / mitigation measures for the proposal.

This investigation included the following aspects:

- A search of all relevant registers of information for listed Aboriginal heritage: the NSW Department of Environment, Climate Change and Water (DECCW) Aboriginal Heritage

Information Management System (AHIMS); the NSW Heritage Office State Heritage Register and Inventory; the Australian Heritage Database (which includes the Register of the National Estate) and the Broken Hill LEP;

- A review of relevant literature including previous consulting reports, academic theses and articles, and published works on the history and ethnography of the area;
- Pedestrian field survey to identify and record all cultural heritage sites and objects within the Study Area;
- Assessments of the significance of recorded sites and the formulation of appropriate management strategies; and
- Completion of documentary evidence (e.g. DECCW Site Cards) for any sites / objects located during the survey for the notification of the relevant authorities.

2.3 Project Constraints

Survey of the Project Site was undertaken via transect survey targeting the most likely landforms for Aboriginal sites. This does not constitute 100% pedestrian survey which is never feasible on a project of this size. Ground surface visibility was generally high and the survey days allowed good survey coverage. Full pedestrian assessment was undertaken for the proposed 22 kV power line.

3 The Study Area

3.1 Landscape context

Understanding the past and present environmental contexts of a study area is requisite in any Aboriginal archaeological investigation (DECCW, 2010). It is a particularly important consideration in the development and implementation of survey strategies for the detection of archaeological sites. Environmental characteristics - including the availability of water, the abundance and type of plant and animal food resources, the nature and type of stone and ochre resources; and the access and the availability of shade and shelter - play an influential role in determining the type and nature of material culture remains that will have been distributed across the landscape by Aboriginal people in the past. In addition natural geomorphic processes of erosion and/or deposition; as well as humanly activated landscape processes - especially those associated with European occupation of Australia - influence the degree to which these material culture remains are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings. The following sections provide information relating to the environmental context of the study area especially where these have the potential to aid the prediction and or explanation of Aboriginal archaeological site location.

3.2 Topography of the Study Area

The study area forms part of the low undulating hills (*i.e*. with relief < 300m AHD) that characterise the southern foot slopes of the Barrier Ranges (Dunn & Sahukar, 2003). The maximum relief of the study area is 293m AHD which is encountered at the south eastern margins of the property adjacent to the Port Pirie - Broken Hill Railway Line. The topographic low within the study area is 273m AHD and this low lies in the northwest portion of the study area at that point where an ephemeral channel adjoining the Old Adelaide Road has been dammed. Although of only low relative relief (*i.e.* 20m) this undulating hill landform is comprised of the following three natural landform elements (*cf*. Hill, 2003):

LFE 1: *Ephemeral channel/alluvial fan washouts*. This landform element is comprised of the narrowly incised ephemeral drainage channels that trend from southeast to northwest across the study area and the bare alluvial fan washout areas that adjoin these channels (**Plate 1**). The channels though variously incised can form erosional gullies to 0.75m deep. The gully banks are comprised of red sandy clay soils that are readily dispersed during rainfall events and the gully floors are typically comprised of deep loose red sands. These ephemeral channels are minor tributaries of Stirling Vale Creek. Exposed claypans within the alluvial fan areas of this landform element are generally covered by a thin deposit of sub-angular quartzose grit. This most likely reflects the deflating nature of this landscape where significant wind erosion has caused the finer sediments to be blown away leaving a moderately sorted layer of gravels too heavy to be wind-transported. Aboriginal stone Artefacts are found to lie within or above this grit layer (**Plate 2**).

LFE 2: Mid-slope bedrock colluvium. This landform element lies between the ephemeral channels and bedrock high points of the study area and is characterised by a coarse gravel to cobble sized colluvium derived from the basement metasediments and comprising quartz, gneiss and schist fragments (**Plate 3**).

LFE 3: Bedrock High/ Bedrock exposures. This landform element consists of rocky high points and/or up-slope outcrops of basement metasediments. It has a variable but quite localised extent within the study area, and is most pronounced at the north east margins of the study area. It also has

occurrences within the mid-west portion of the study area adjacent and to the west of the current north-south trending fence line (**Plate 4**).

A further non-natural landform element is also described for the study area:

LFE 4: Disturbed hill slope tracks: This landform element consists of a number of graded, gravel tracks approximately 5m to 8m wide that variously cross the landscape of the study area (**Plate 5**).

3.3 Geology and soils

Situated within the Adelaide Fold Belt Geological Province the basement geology of the study area is dominated by Early Proterozoic rock units and intrusives of the Willyama Supergroup (Brown, 1983). The principal basement lithology is comprised of interbedded metasediments of variously proportioned psammite, psammopelite and pelite rich rock units. Psammite rich rock units are described as being comprised of massive, fine to medium grained blue-grey quartz rich rocks with minor feldspars, biotite and garnet. Pellite rich rock units are comprised of medium to coarse-grained micaceous or sillminite rich schists and gneiss. Minor occurrences of pegmatite and /or intermixed pegmatite K-feldspar quartz rich rock units also form part of the lithological sequence described for the study area. Overlying this basement geology are Cainozoic derived units of sand and gravels (Brown, 1983, Hill, 2003).

3.3.1 Geomorphic activity

The Study Area is best described as a degrading landscape where the effects of erosion, particularly wind erosion are pronounced; especially in the alluvial fan outwash areas of Landform Element 1 (see Section 3.1). This is in keeping with broader geomorphic assessments of the Broken Hill Region (e.g. Wasson & Galloway, 1986; Fanning, 1999) that have shown that the impacts of European occupation - including those impacts associated with the introduction of domestic grazing and feral animals, and the widespread clearing of Mulga vegetation for pastoral fencing and/or mining activities - have caused modern erosion rates between 50 and 145 times greater than those natural rates of erosion estimated to have occurred prior to European occupation. Water erosion also occurs across the study area and this typically takes the form of hill-slope sheetwash and/or rill and gully erosion associated with high energy water flow in the ephemeral channels. It is also noted that some aggradation is observed as red sandy alluvial deposits in the deepest of the incised ephemeral channels. This is likely to be episodic aggradation dependent on the energy and volume characteristics of water flow through each of the ephemeral channels.

3.4 Hydrology of the Study Area

The Broken Hill region is located in the west of the Barwon-Darling Catchment. It covers over 142,000 square kilometres and is a subcatchment of the Murray-Darling Basin. The hydrological regime of the study area reflects both its situation within an arid landscape and the effects of localised topography and is interpreted to take the following two general forms:

1. In-channel episodic moderate to high energy water flow – During moderate to heavy rainfall associated with localised storms events, fast flowing waters enter the upstream portion of ephemeral channels and are quickly borne downstream through the study area. These waters (a) disperse the sandy clay matrix of the channel banks such that localised erosion results (b) transport and deposit entrained upstream sediments away from their source zones; and (c) cause overbanking of channels with outwash on to adjoining alluvial fans. This outwash, being no longer entrained within the channel, flows much less rapidly across the landscape, and is entrapped within shallow clay pan areas until it evaporates.

2. Sheetwash on stony hill slopes – In the mid-to-upslope areas of exposed bedrock and/or bedrock colluvium with limited to no soil development all rainfall is expected to be dispersed downslope as sheetwash.

Key rivers which flow within this catchment include the Darling River, Barwon River and associated anabranches. Drainage on the site is characterised by a creek system that is a tributary of the Stirling Vale Creek. The Stirling Vale creek catchment emanates from land immediately west of Broken Hill. The creek system on the site flows from the south eastern boundary at the Railway in a north easterly direction. The egress point is located approximately 400 metres from the north eastern corner, where a farm dam lies within the creek. Major overflows would fill and bypass this dam and continue towards the Stirling Vale Creek, which is flowing in a southerly direction. The catchment of the creek system on the site is contained within the site boundary. Small catchments at the perimeter flow out of the site to other creeks.

3.5 Vegetation of the Study Area

Approximately 95 per cent of native vegetation in the region remains unmodified except for grazing. From an assessment of the aerial photography, the proposed solar PV project and transmission line is located in an area that is largely devoid of vegetation, and may be subject to grazing with considerable erosion present across the entire site. The vegetation of the study area can be broadly categorised as a mixed low Bluebush (*Maireana spp*) / Bladder Saltbush (*Atriplex vesicaris sensu lat*.) chenopod shrubland (**Plate 6**). The persistence of this shrubland across the variously stony, low hill landform of the study area further characterises this shrubland as a Gibber Chenopod Shrubland (Keith 2004; Benson *et a*l; 2006). Due to late winter rains ephemeral herbs such as Sturt's Desert Pea (*Swainsonia formosa*) and some grasses have flourished to thicken the understorey and make the vegetation cover more dense than is average for this type of shrubland (**Plate 7**). Occasional clumps of woody *Acacia spp* to 1.2M tall, containing both dead and live bushes occur where the skeletal soils deepen along the ephemeral channels.

3.6 Climate of the Study Area

The climate of the study area is described as being persistently hot and arid (Stern, 2000) with a mean maximum summer temperatures of 32°C and an average annual rainfall of less than 250mm (Dunn & Sahukar, 2003). Rainfall is typically non-seasonal, with the yearly average being achieved through the accumulation of a high number of low rainfall events across all seasons (82% of rainfall occurring is less than 5 mm (Bureau of Meteorology 2004).

3.7 Land–use history

The history of European exploitation of the landscape about Broken Hill is one of environmental change and devastation. As required, in the 1860s pastoralists moved beyond the already occupied margins of the Darling River in search of new grazing land. Due to increased wool commodity prices, and the development of leasehold tenure in the Western Division as a result of the introduction of the Crown Lands Act 1884, stock numbers surged and more intensive grazing on native vegetation was the result (Dibden, 2007). By the 1890s the pastoral industry was increasingly reliant on the extraction of water from bores to sustain stocking rates and with deteriorating native vegetation resources - both as a result of the intensive sheep grazing, and the impacts of recently introduced rabbits - it became vulnerable to drought. As well as the exploitation of chenopod shrublands as fodder for stock, the early pastoralists of the Broken Hill district also widely exploited mulga vegetation using it both as a stock-feed in time of drought; and more extensively as fence posts.

In addition to the significant deleterious effects of pastoralism the discovery of exploitable mineral resources in the Broken Hill area in 1883 led to further rapid destruction of the vegetation, particularly the mulga scrub. When mining operations commenced at Broken Hill the dense mulga scrub surrounding the nascent town was completely harvested to provide fuel for the population and to facilitate the mining processes themselves (Solomon, 1988). The result was that almost all the trees were cut down within a few days travel of the mining town. In addition, to feed the burgeoning mining population the immediate area was further overstocked with concomitant effects to the native shrublands. With significantly reduced vegetation cover the skeletal Cainozoic soils and sand deposits of the region were laid bare and these became increasingly susceptible to wind erosion with frequent and severe sandstorms being the result. The “Federation drought’ of the late 1890s and early 1900s as well as drought periods in the 1930s and 1940s are all remarked upon as periods of incessant and severe wind/dust storms (Solomon, 1988).

3.8 Soils and Existing Levels of Disturbance

In-field observations of a number of existing landscape features attest to the fact that the study area has been subject to a number of disturbances in the recent and historic past. These include:

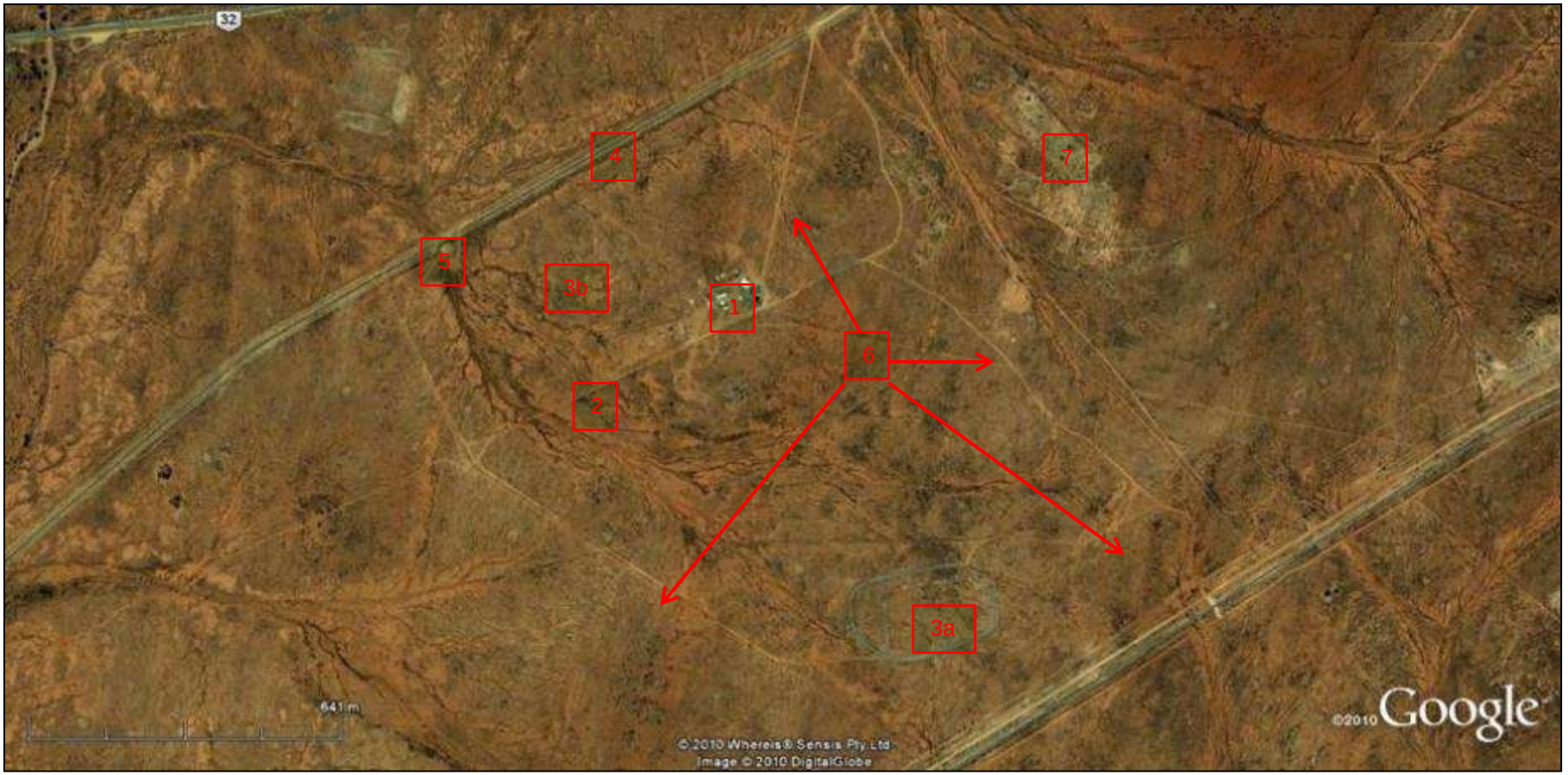
- A residential dwelling and associated out-buildings are situated within the northeast of the study area (**Figure 3**; **Plate 8**).
- A transmission line easement crosses the study area from west to east. Disturbances associated with this easement include those related to the original installation of each overhead pole and line, as well as to the installation and maintenance of the access track along this utility easement (**Figure 3**; see **Plate 5**).
- Two circular track features are discernible in aerial photography dated to 2004. These appear to be either associated with horse and or motorcycle recreational pursuits (**Figure 3**).
- The Old Adelaide Road marks the northern boundary of the study area. As well as the inevitable ground disturbing works associated with the construction, development and upkeep of this bitumen road, its more recent de-commissioning has included the removal of the bituminised surface (**Figure 3**).
- A dam has been emplaced in an ephemeral channel to impede drainage and allow water storage (**Figure 3**; **Plate 9**)
- Numerous graded gravel tracks cross the study area and give access to all landform elements within it (**Figure 3**; **see Plate 6**).
- The property is bounded by star picket and wire fences (**Plate 10**).
- The skeleton of a horse and numerous, variously sized, horse shoes were observed in the field, particularly within the alluvial landform element. Though no horses were immediately observed at the time of the study, it is clear that the study area has served as horse paddocks in recent times.
- To the south of the study area, a culvert inserted to support the Port Pirie to Broken Hill Railway line, appears likely to have caused changes in channel and/or flow regimes downstream that would immediately impact on the study area (**Plate 11**).

- To the east of the main study area in the transmission line easement there is significant ground disturbance associated with mounded hills to 2-3 metres in elevation. These have been used as motor-cycle jumps (**Figure 3**).
- The remainder of the ETL easement has either undergone disturbance via the construction of the existing power line or remains relatively undisturbed (**Plates 27-29**)

3.9 Conclusions re Aboriginal Site Location in relation to Environmental Settings

The examination of the environmental contexts of the study area points to the following controls on the nature and type of archaeological record to be found within it:

- The ephemeral nature of the water courses within the study area suggests that ancestral Aboriginal parties of groups would not have camped in the area in either large numbers and/or for long (if any) periods of time.
- The denudation of trees from this landscape in the historical period precludes scarred trees being found within the study area.
- The bedrock geology contains quartz which is a texture variable stone that may be suitable for artefact manufacture.
- The bedrock geology is not sedimentary and hence grinding grooves are not expected to be found; this is especially so given the intermittent nature of water flow within the study area.
- The skeletal nature of the sand and gravel deposits across the study area precludes there being sufficient sediment for the interment of ancestral Aboriginal remains within the study area.
- The effects of both water and wind erosion across the study area is likely to mean that Aboriginal objects if found will not be *in situ* nor will they be associated with significant archaeological deposits.



LEGEND: 1 **Residential building** 2 **Transmission Line Easement** 3a &3b **Circular track features** 4 **Old Adelaide Road** 5 **Dam** 6 **Track**
7 **Disturbed area with an irregular sequence of raised mounds criss-crossed by motorcycle tracks**

Figure 3: Current land use features of the study area. (Source: Google Earth 2010: Base Aerial Photography, November 2004).

4. Aboriginal Heritage Assessment: Background

4.1 Ethno-historic Sources of Past Aboriginal Culture

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 kms to the west (Cowling 1995: 4). Although not a large population, they are said to have been permanent dwellers of the area. According to Martin (1995: 3), relying on oral history and ethnographic accounts, the Broken Hill area is also said to be a "place of convergence of several important myths".

Some recording of early interaction between explorers and Aborigines exists, although this must be accepted with the lack of objectivity with which it was documented. According to Brock 1988 (as reported in Martin 1989: 6), the local Aborigines were described by Sturt as fine looking, although further to north around Gairdners Creek, a group encountered were described as starved in appearance. Native huts (16) were also noted along Floods Creek, close to Gairdners Creek, north of Yanco Glen. Emu traps and stone arrangements were also recorded.

After the onset of European occupation, traditional, Aboriginal life quickly ceased to exist in its pure form. Disease had preceded occupation, decimating the population and then in the following decade, battles with colonists further reduced the Indigenous population numbers. Although resistance was strong initially new waves of colonists in the 1860's ensured increasingly less opposition through being more effectively armed. Conflict continued until the 1870's when the Aborigines slowly became part of the pastoral economy.

4.2 Regional Archaeological Context

In general, western NSW has been the focus of a fair degree of archaeological research, primarily concerning the archaeology of the ephemeral lakes and their associated Pleistocene lunettes and with regard to the art sites of the region. One of the earliest dated sites in western New South Wales is Lake Yantara (c. 250 kms north of Broken Hill), where a hearth has been carbon dated to 26,200±1,110 BP (Dury and Langford-Smith 1970 as report in Barton [Austral] 1999: 4). Panaramitee style pecked engravings at Sturts Meadow may also date to the final phase of the Pleistocene era. Closer to Broken Hill there is extensive evidence for Late Pleistocene occupation along the Darling River and many dates confirm this, ranging from 27,000 BP to the present, with older dates still from the Lake Mungo area, ranging between 33,000-24,000 BP (Barton in Austral 1999: 4).

More recently, Holdaway *et al.* (2002) have attempted to resolve questions relating to the chronology of Aboriginal occupation in the arid margins of southeastern Australia in areas well away from major rivers and lakes. In an area to the North of Broken Hill, Holdaway et al. (2002) dated charcoal deposits found in 28 heat retainer hearths in Sturt National Park. This demonstrated hearth construction in the area for at least the last 1700 years, but with a gap of 200 - 400 years between 820 ± 50 and 1170 ± 130 years BP. This finding was interpreted as demonstrating a hiatus in occupation of the area. However, while Holdaway *et al*. (2002) suggest the possibility that palaeo-environmental fluctuations resulted in this discontinuity of occupation, they nevertheless advised caution in postulating causes until further research had been conducted. Likewise Shiner (2006) also found a discontinuity in landscape occupation over the last 2000 years when dating 16 hearths in conjunction with an analysis of the surface stone artefact assemblage from Pine Point and Langwell Stations, located just to the south of the foothills of the Barrier Range. Shiner (2006) found that the different artefact assemblages he examined represented unique occupational histories, but that these were punctuated by long periods with scant evidence of Aboriginal presence or activity.

Johnston & Witter (1996) conducted a project to develop a predictive model for Aboriginal archaeological site locations in western New South Wales. Expert system forecasts, archaeographic modelling based on groups of land systems and their margins; and in-field reliability testing were employed to assess and characterise the distribution of Aboriginal archaeological material across the landscape. In essence the fundamentals of the predictive model determined by Johnston and Witter (1996) for the semiarid to arid landscape of New South are that:

- Occupation can be expected near to water; and the abundance of archaeological evidence should be proportional to the quality of the water source, considering factors such as reliability, salinity and production of vegetation;
- Occupation can be expected to focus on ecotonal boundary areas; people prefer to occupy certain environmental types which need to be ranked with regard to factors such as the presence of ephemeral water, food resource abundance and food resource diversity;
- Varying effective visibility should be taken into account for each environmental type so that potential biases can be avoided. Then the information derived would relate to the archaeology and Aboriginal heritage present in an area, rather than only that which can be detected;
- Where stone sources are known to exist artefacts can be expected in extreme abundance within a radius of two kilometres and in increased numbers within a radius of twenty kilometres;
- Other factors such as areas of known population focus, zones of exceptional productivity and food abundance could have been such a centre of activity in the landscape that a halo effect may have resulted. Within localised study areas more small scale influencing factors that are difficult to consider within a regional model may be of use.

In addition to this research, more recent development driven / EIA studies have predominated in the region, leading to the recording of many more sites, although within the Barrier Ranges themselves, archaeological exploration has remained somewhat more limited. The following provides a summary of EIA studies relevant to the current proposal, and it is noteworthy that a more detailed review of archaeological sites in the region can be found in Dibden 2008.

The Living Desert Area

Martin (1995 and 1998) conducted two archaeological surveys in the vicinity of the Living Desert area which is situated immediately to the north of the City of Broken Hill. These studies indicated that:

- intensive exploitation of quartz reefs occurred throughout the Hills especially where with Rock Outcrops dominated the landform;
- large complex campsites occur in the Upper Creeks containing heat retainer ovens, seed grinding material, flaking areas, and a range of flaked artefacts dominated by quartz but including on average <5% silcrete/chert;
- less abundant, less varied archaeological material occurs on Low Ridges and the Undulating Uplands landforms; and
- 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.

In addition two more unusual site types were recorded in the Living Desert Area. The first is was rock engraving site with engraved circles, animal tracks, and also a panel of small cupules (Martin, 1998b). This is the only known engraving site in the area immediately surrounding Broken Hill, although engravings are known further to the west and north. The second unusual site type are rock holes with stone lids (Gnamma holes), the stone lids are presumed to be used so as to prevent the evaporation of water and its use by animals.

Appleton (1999) also surveyed a section of the Living Desert Area including a portion that overlapped with the previous surveys of Martin. He recorded 20 sites including seven artefact scatters, two heat retainer ovens and one oven complex, three isolated artefacts, and seven quartz reef quarries and associated artefacts. Appleton found that some of the quartz reefs in the hills had been extensively exploited for suitable material for flaking, and that flaked material in the area was dominated by quartz, with some quartzite and silcrete artefacts.

'The Pinnacles'

Approximately 7 km to the west of the 170 ha Study area is the three peaks of the topographic feature referred to as 'The Pinnacles'. In 1992 Lance, surveyed a proposed amphibolite quarry in the vicinity of Hungary Hill and the Middle Pinnacle (Martin, 1998). He recorded one artefact scatter on the top of Hungary Hill and a very low background density over the slopes of Hungary Hill and the bottom of the Middle Pinnacle. The artefact scatter on top of Hungary Hill consists of 31 quartz artefacts including 1 backed blade, 12 flakes, 1 core, 16 flaked pieces and 1 retouched piece.

After "The Pinnacles" were gazetted as an Aboriginal place in 1996, Martin (1998a) was employed to conduct a more comprehensive survey of the area. This survey revealed a distinctive patterning of archaeological material around "The Pinnacles" that was strongly influenced by the geomorphic and topographic characteristics of the area:

- *Pine Creek and Stirling Vale Creek*: In the vicinity of 'The Pinnacles' campsite material was found to be concentrated in two areas along Pine Creek and in one area on Stirling Vale Creek. All three areas contained ovens and food processing equipment including grinding dishes and mortar/pestle type artefacts. Apart from these three areas there was a consistent low to medium density scatter of material along both creeks with only occasional ovens and rare grinding equipment;
- *Rolling Lowlands:* The lowland hills adjacent to 'The Pinnacles' contained significant campsite material especially where these lowlands occurred adjacent to the main Stirling Vale and Pine Creeks; and
- *Conical peaks of the South, Middle and North Pinnacles*: No archaeological material occurred on the conical peaks of 'The Pinnacles although a very low density background scatter was identified on the lower colluvial slopes of these peaks.

This survey was subject to review when the then Department of Environment and Climate Change (now OEH) commenced legal proceedings against Pinnacle Mines for causing damage to a gazetted Aboriginal place and recorded archaeological material in adjacent areas (i.e. Garrett vs Williams, 2007). Macintyre-Tamwoy (2006) acting for the defendant, re-recorded the large open sites on both sides of Pine Creek near the South Pinnacle identified by Martin (1998a) and found another area with a high density of artefacts to the west of the Middle Pinnacle in an area not surveyed by Martin (1998a). However, Macintyre-Tamwoy concluded that none of the quartz outcropping at 'The Pinnacles' have been used as a raw material for artefact manufacture and that the quarries sites recorded by Martin (1998a) did not, in her opinion show any evidence of exploitation by Aboriginal

people. This conclusion was also supported by Wright (2006) who examined Martin's (1998a) Site 38 and found that it had a very low density of artefacts, so low that he calculated it to be consistent with the background density found all over Australia, and that most of the quartz material was naturally occurring 'lag' quartz.[2]

Bemax Mineral Separation Plant survey

During the assessment of the Bemax Mineral Separation Plant, which is located immediately to the southeast of the study area, Gay (2001) identified 16 sites including open camp sites and quartz quarries. The camp sites 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.

Silverton Wind Farm Stage 1:

In 2008 Dibden identified a total of 262 Aboriginal object locales during field survey of the Silverton Wind Farm Stage 1 proposal area (Dibden, 2008). The majority (N=166; 63.4%) of locales were distributions of predominantly quartz stone artefacts across individual survey units. A total of 78 quartz outcrops with evidence of exploitation, were recorded. Fourteen locales contained stone artefacts with heat retaining hearths (Dibden, 2008). In addition three isolated artefacts and a complex of two small circular stone arrangements were recorded. Dibden (2008) recognised the following patterning in artefact type and distribution across this landscape which she concluded was indicative of the variable use of different landforms by Aboriginal people within the area:

- 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 in which quartz outcrops are present. The majority of stone artefacts are unretouched flakes and cores however 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 present in the artefact assemblages and stone heat retainer ovens/hearths are common in these lower landforms (Dibden 2008).

During the assessment of the Bemax Mineral Separation Plant that is located immediately to the southeast of the study area (Gay, 2001) identified 16 sites including open camp sites and quartz quarries. Camp sites 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.

4.3 Local Archaeological Context

When this project was first initiated, Sinclair Knight Mertz undertook a search of the then Department of Environment Climate Change and Water (DECCW) Aboriginal Heritage Information Management System (AHIMS) which showed that there were 55 previously recorded Aboriginal heritage sites

[2] In the adversarial context of legal proceedings, it is difficult to reconcile the disparate views of the archaeologists in this case, however, it is pertinent to recognise that quartz is a variable textured material, and hence sometimes difficult to reliably determine whether it is artefactual or not; and this is increasingly difficult where it is a majority component of the basement geology as does occur in the Study Area.

within a 5km radius of the proposed solar PV plant and transmission line. When placed in their locational context, it is apparent that the majority of sites are situated in close relative proximity to watercourses, particularly Stirling Vale Creek and its tributaries (**Figure 4**). Of the 55 recorded sites only 17 are located within 2km of the Study Area and the majority of these are artefact scatters (Table 2).

Table 2: AHIMS registered sites within 2km of the Study Area.

Site ID	Site Name	Distance to PV Plant
23-4-0081	AS1	1.4 km (920m to TLE*)
23-4-0082	AS3	1.4 km (900m to TLE)
23-4-0083	AS4	1.2 km (950m to TLE)
23-4-0084	AS5	1.1 km (1.3km to TLE)
23-4-0085	AS6	1.8 km (110m to TLE)
23-4-0086	AS7	920m (1.2km to TLE)
23-4-0087	AS8	920m (1.5km to TLE)
23-4-0088	AS9	700m (720m to TLE)
23-4-0089	AS10	700m (560m to TLE)
23-4-0090	AS12	820m (540m to TLE)
23-4-0091	AS16	560m (800m to TLE)
23-4-0092	AS15	640m (1km to TLE)
23-4-0093	AS14	475m (680m to TLE)
23-4-0111	AS11	1.7km (540m to TLE)
23-4-0112	AS2	1.9km (700m to TLE)
23-4-0107	AS13	1.4km (620m to TLE)
23-4-0615	SU278/L9	1 km

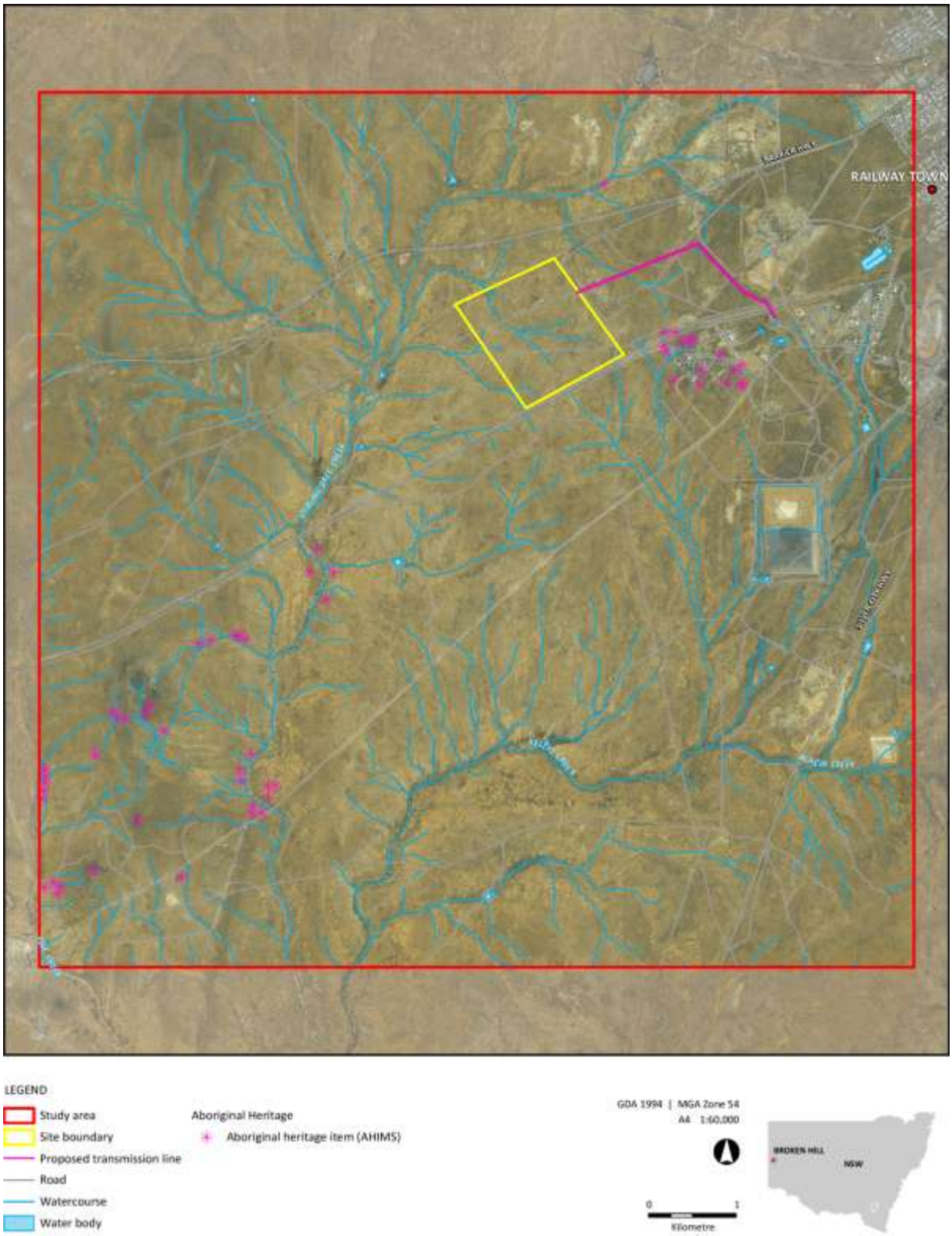
*TLE= Transmission Line Easement

A more recent search has since been conducted of the Office of Environment and Heritage (OEH) AHIMS to ensure any newly added sites are captured in this assessment. This search covered a 4 x 3 km area (GDA, zone 54, 535500-539500E; 6459500-6462500N, search date 7.6.2012) and returned 16 Aboriginal sites. It is clear from this search that no new Aboriginal sites have been recorded within the Project Area and immediate surrounds since the first search in 2010.

As already alluded to in Section 4.2, of the registered Aboriginal sites situated greater than 2 km away from the Study Area, "The Pinnacles" (AHIMS Site # 31-1-0019; 6.7km distant) is noteworthy because:

1. "The Pinnacles" is a declared Aboriginal Place and as such is recognised to be of considerable cultural significance to the Local Aboriginal Community (NSW Government Gazette, 1996, 81: 3947).
2. "The Pinnacles" have been the subject of a recent legal case [Garrett Vs Williams, 2007 151 LGERA 2] in which a mining company pleaded guilty to causing deliberate harm to Aboriginal objects within a declared Aboriginal place.
3. "The Pinnacles" is a prominent landscape feature that is visible in the western skyline of the Study Area.

Figure 4: A map of the recorded sites within a 5km radius of the study area (Source: Sinclair Knight Mertz, 2010).



4.4 Predictive Model for Site Location

Across Australia, numerous archaeological studies in widely varying environmental zones and contexts have demonstrated a high correlation between the permanence of a water source and the permanence and/or complexity of Aboriginal occupation in that same watered area (e.g. Johnston & Witter, 1996; McDonald CHM, 1997). This is generally reflected in a greater complexity in the lithic assemblages from sites close to permanent water relative to those near ephemeral water sources. The greater density and diversity of artefact types and raw material types in those sites adjacent to permanent water has led archaeologists to suggest that a diverse range of activities (e.g. tool use, manufacture and maintenance, food processing and quarrying) have occurred in these areas. In contrast, sites near ephemeral water sources often have less diverse lithic assemblages and are more likely to contain evidence suggestive of with one-off occupation and/or random traverse (e.g. isolated knapping floors or tool discard). The confluence points of rivers and minor creeks often also contain sites with complex lithic assemblages, and this is generally interpreted as demonstrating that these water points were also focal points for Aboriginal occupation. This interpretation however requires close scrutiny of the local geomorphic context and sedimentation regimes since fluvial processes may entrap, re-work and re-deposit stone artefacts in stream convergence points some considerable distance down -stream from their original manufacture and/or discard point.

Site location is also affected by the availability of and/or accessibility to a range of other natural resources including: plant and animal foods; stone and ochre resources and rock shelters; as well as by their general proximity to other sites/places of cultural/mythological significance. Consequently sites tend to be found along permanent and ephemeral water sources, along access or trade routes or in areas that have good flora/fauna resources and appropriate shelter.

In formulating a predictive model for Aboriginal archaeological site location within any landscape it is also necessary to consider post-depositional influences on Aboriginal material culture. In all but the best preservation conditions very little of the organic material culture remains of ancestral Aboriginal communities survives to the present. Generally it is the more durable materials such as stone artefacts, stone hearths, shell, and some bones that remain preserved in the current landscape. Even these however may not be found in their original depositional context since these may be subject to either (a) the effects of wind and water erosion/transport both over short and long time scales or (b) the historical impacts associated with the introduction of European farming practices including: grazing and cropping; land degradation associated with exotic pests such as goats and rabbits and the installation of farm related infrastructure including water storages, utilities, roads, fences, stockyards and residential quarters. Scarred trees may survive for up to several hundred years but rarely beyond.

The examination of the environmental contexts of the study area (Section 3.7) when supported by the desktop review of the known local and regional archaeological record (Sections 5.1 and 5.2) allows the following predictions to be made with respect to the Aboriginal archaeological signature expected within it:

- In the vicinity of the ephemeral drainage channels of Landform Element 1, archaeological evidence may be sparse, but may indicate focused activity (one-off camp sites and knapping events). Isolated stone artefacts and/or low density artefact scatters are the most likely site type to be encountered in this landform element.
- On the colluvial slopes of Landform Element 2- especially when these are over 200 m from water, archaeological evidence is likely to be sporadic if present at all.

- Quartz rich units of the Proterozoic metasediments that form Landform Element 3 may be suitable for stone artefact manufacture, and hence stone artefact extraction sites may be found within this landform element. However, the limited nature of bedrock exposures within the study area, coupled with the variable nature of the quartz rich rocks; and the variable nature of their inter-bedding as metasediments, significantly reduces the likelihood that stone quarries will be identified within this Landform Element.
- The graded tracks of the study area (described as Landform Element 4) provide good access across all landform elements and provide good ground surface visibility so they have the potential to yield archaeological material. For the purposes of the current study, the site type definitions can be found in Appendix 2.

4.5 Field Methods and Archaeological Survey Sampling Strategy

Standard archaeological field survey and recording methods were employed in this study (cf. Burke & Smith, 2004). A total of 19 foot traverses were made across the Project Site study area. Transects were selected to ensure sampling of each of the landform elements described in Section 3.1 (Figure 5). The length of each transect was arbitrarily determined but was usually 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 maximum width of walked transects in this archaeological survey was *c*. 80 m (i.e. 4 persons x 20 m wide transects). A focus of the transect survey was to ensure that all ephemeral channels and associated alluvial fans (i.e. Landform Element 1) across the study area were subject to concentrated visual inspection since within local and regional contexts these have been shown to almost routinely contain Aboriginal objects. Graded tracks were also examined where possible because they provided good ground surface visibility and exposure and allowed sampling access to all other landform elements.

Complete pedestrian survey was afforded the transmission line route.

5 Results of Aboriginal Heritage Assessment

5.1 Effective Survey Coverage

The survey of the Study Area was undertaken over two field trips, the first of two days duration during November 2010 and the second of one day duration in March 2011. OzArk staff was accompanied by BHLALC representatives on both trips. Transects were located to achieve the best total survey coverage of the Project Site, while the transmission line underwent full pedestrian survey.

The total effective survey coverage (or EC) achieved during this survey was calculated to be 19.5% of the total 170 ha study area (**Tables 3 & 4).** This effective coverage was not consistent across all landform elements such that the effective coverage achieved in Landform Element 1: Ephemeral channels/alluvial fan washout accounted for 11.7% (i.e. 60%) of the total effective coverage of the survey area (**Table 5**). Whilst this is in part a function of sampling bias - since the ephemeral channels and alluvial fan washouts were targeted as the most likely landform elements to contain Aboriginal artefacts – it is also a consequence of the interplay between ground surface visibility and the frequency of suitable exposures within each landform element. Ground surface visibility was generally good across all transects surveyed, ranging between 50-90% in all but Transect 13 where ground surface disturbances associated with the decommissioning of the Old Adelaide Road reduced visibility to 25%. Likewise though slightly more variable, exposures comprised 50-90% of all suitable land surfaces within most transects. Once again however the ground surface exposure was reduced to 25% in Transect 13 due to the decommissioning of the Old Adelaide Road.

Full pedestrian survey coverage was made of the Electricity Transmission Line in a second field trip. The ETL goes beyond the limits of Figure 5, but can be seen on **Figure 4**.

Given the generally good ground surface visibility, reasonable distribution of exposures and the systematic sampling of all landform elements within the study area it is considered that the study area has been adequately surveyed for its archaeological potential. It is however, acknowledged that all survey achieves a representative sample only and hence it is possible that there may still be further undetected Aboriginal sites within the Study Area. However, on the basis of the results achieved in this survey (i.e. Section 5.2) and the comparable nature of the sites identified with those found locally elsewhere in similar contexts, it is expected that any undetected site is unlikely to be large and/or complex and most probably only likely to be an isolated artefact.

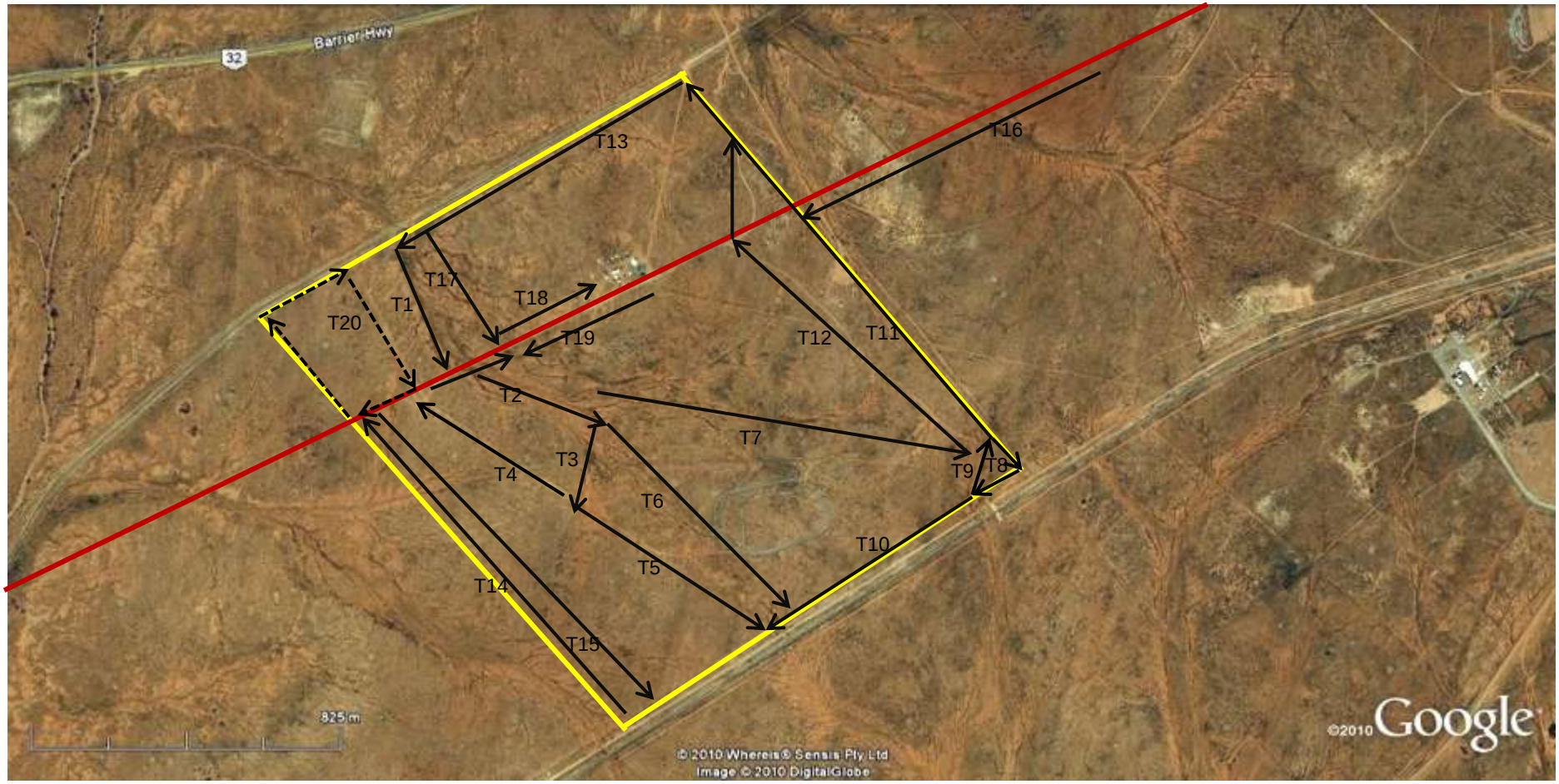


Figure 5: Map of general location and direction of survey transects. T1-19 were undertaken via foot traverse and T20 was subject to a reconnaissance vehicle traverse only.

Table 3: Details of Survey Transects and Survey Coverage Data

Transect No.	Transect Start (GDA)	Transect End (GDA)	Length in m (L)	Width in m (W)*	Survey Area in sq. m (L x W)	Archaeological Visibility (%)**	Archaeological Exposure (%)***	Effective Coverage (sq. m) (= Survey Unit Area x Visibility % x Exposure %)	Effective Coverage (%) (= Effective Coverage Area / Survey Unit Area*** x 100)
1	05 36 343 E, 64 61 354 N	05 36 476 E, 64 61 026 N	353.9393	80	28315.14083	50	90	12741.813	45
2	05 36 466 E, 64 61 026 N	05 36 829 E, 64 60 786 N	435.1655	80	34813.23886	50	90	15665.957	45
3	05 36 829 E, 64 60 786 N	05 36 867 E, 64 60 541 N	247.9294	80	19834.35404	50	90	8925.4593	45
4	05 36 867 E, 64 60 541 N	05 36 328 E, 64 60 966 N	686.4008	20	13728.01515	90	80	9884.1709	72
5	05 36 867 E, 64 60 541 N	05 37 225 E, 64 60 278 N	444.2218	20	8884.435829	90	80	6396.7938	72
6	05 36 661 E, 64 60 947 N	05 37 245 E, 64 60 278 N	888.0411	40	35521.64411	50	70	12432.575	35
7	05 36 661 E, 64 60 947 N	05 37 689 E, 64 60 807 N	1037.489	60	62249.35662	50	80	24899.743	40
8a	05 37 781 E, 64 60 844 N	05 37 923 E, 64 60 654 N	237.2003	20	4744.006745	90	80	3415.6849	72
8b	05 37 923 E, 64 60 654 N	05 37 771 E, 64 60 579 N	169.4963	20	3389.926253	90	80	2440.7469	72
9	05 37 771 E, 64 60 579 N	05 37 781 E, 64 60 844 N	265.1886	60	15911.31673	90	80	11456.148	72
10	05 37 771 E, 64 60 579 N	05 37 225 E, 64 60 278 N	623.4717	20	12469.43463	90	80	8977.9929	72
11	05 37 781 E, 64 60 884 N	05 37 088 E, 64 61 762 N	1118.541	20	22370.81134	90	80	16106.984	72
12a	05 37 689 E, 64 60 807 N	05 37 169 E, 64 61 294 N	1087.394	40	43495.74692	50	80	17398.299	40
12b	05 37 169 E, 64 61 294 N	05 37 088 E, 64 61 762 N	474.9579	40	18998.31571	50	80	7599.3263	40
13	05 37 088 E, 64 61 762 N	05 36 182 E, 64 61 318 N	1008.946	30	30268.37954	25	25	1891.7737	6.25
14	05 36 794 E, 64 60 045 N	05 35 719 E, 64 60 722 N	1270.415	80	101633.1914	75	90	68602.404	67.5
15	05 35 954 E, 64 60 818 N	05 36 841 E, 64 60 070 N	1160.29	80	92823.204	75	90	62655.663	67.5
16****	05 38 439 E, 64 61 822 N	05 37 376 E, 64 61 335 N	1149.321	30	34479.62007	50	50	8619.905	25
17	05 36 345 E, 64 61 395 N	05 36 713 E, 64 61 118 N	460.6007	80	36848.05558	50	90	16581.625	45
18	05 36 448 E, 64 61 096 N	05 36 828 E, 64 61 164 N	386.0363	80	30882.90142	50	90	13897.306	45
19	05 36 832 E, 64 61 158 N	05 36 595 E, 64 61 062 N	255.7049	60	15342.29448	50	90	6904.0325	45
					Total Survey area = 632523.7702 m2			Total EC = 328874.5 m2	Total EC = 19.5%

* Maximum transect width is presented only; ** Average % visibility given low and variably sparse chenopod shrubland as ground cover; *** Average % of natural ground surface visible when exposed; ****Transect 16 lies outside the main survey area along the transmission line easement in the adjoining crown reserve and hence this data is not included in the total survey area or EC Calculations..

Table 4: Landform summary—Main survey area

Landform	Landform area (sq m)	Area Effectively Surveyed (sq m) (= Effective Coverage Area)	% of Landform Effectively Surveyed (= Area Effectively Surveyed / Landform x 100)	Number of Sites	Number of Artefacts or Features
Low Hill	1685000	328874.5	19.5	13	N/A

Table 5: Landform Element Summary – main survey area

Landform Element	Transect	Landform Element area (sq m)	Area Effectively Surveyed (sq m) (= Effective Coverage Area)	% of Landform Element Effectively Surveyed (= Area Effectively Surveyed / Landform x 100)	Number of Sites	Number of Artefacts or Features
Ephemeral Channel/alluvial fan washout	T1, T2 T14, T15, T17, T18, T19	340658.03	197048.801	11.7	13	17
Mid slope Bedrock Colluvium	T3, T6, T7, T12	180099.42	71255.4025	4.23	1	13
Bedrock High/Bedrock exposure	T8, T9	24045.25	17312.5798	1.03	0	0
Disturbed Hill slope track	T4, T5, T10,T11, T13	87721.076	43257.7155	2.57	0	0

5.2 Aboriginal Sites Recorded

Within the main survey area a total of 13 Aboriginal archaeological sites[3] were identified and one further archaeological site was identified adjacent to the transmission line easement in the adjoining crown reserve to the east of the main survey area (Table 6, Figure 6). The majority of these sites were located in bare alluvial fan washout areas associated with the narrowly incised ephemeral drainage channels that trend from southeast to northwest across the study area. The sites identified were either isolated stone artefacts or low density stone artefact scatters. Three raw material types were identified within the sites being silcrete, chert and quartz, with silcrete being the dominant raw material. Further detailed description of each site is provided below.

3 Site boundaries are frequently arbitrarily determined (Burke & Smith, 2004). For this survey, on ground perception that two Aboriginal objects were greater than 25m apart resulted in them being determined to be separate 'sites'.

Table 6: Survey results.

Site Number	Feature(s)	Survey Unit (Transect #)	Landform Element #
BHS-1	Isolated artefact		1
BHS-2	Isolated artefact	2	1
BHS-3	Isolated Artefact	2	1
BHS-4	Isolated Artefact	2	1
BHS-5	Isolated Artefact	2	1
BHS-6	Isolated artefact	2/3	1
BHS-7	Isolated Artefact	2	1
BHS-8	Isolated Artefact	2	1
BHS-9	Artefact Scatter	3	2
BHS-10	Isolated Artefact	14	1
BHS-11	Artefact Scatter	16	1
BHS-12	Artefact Scatter	17	1
BHS-13	Isolated artefact	17	1
BHS-14	Isolated artefact	19	1

BHS-1 (Broken Hill Solar - Site #1)

Site type: An Isolated find/ single artefact (see **Plate 12**)

GPS Coordinates: 5 4 J 0536478 E 646 0952 N

Location of site: Within survey transect 2 BHS-1 is located approximately 85m southeast of the transmission line easement, at a bearing of 134°. The site is situated on an area of exposed alluvium less than 15m from a narrow ephemeral channel/gully (Figure 5.2).

Description of site: This isolated find consists of the distal end of a broken silcrete flake that is retouched on the ventral surface.

BHS-2 (Broken Hill Solar - Site #2)

Site type: An isolated find/ Single artefact (see **Plate 13**)

GPS Coordinates: 54 J 053 6536 E 6460959 N

Location of site: BHS-2 lies approximately 60m east of BHS-1 at a bearing of 84°. The site is situated on an exposed alluvial fan/claypan area within a sparse open chenopod shrubland (Figure 5.2).

Description of site: A small, moderately coarse-grained silcrete, multi-platform core.

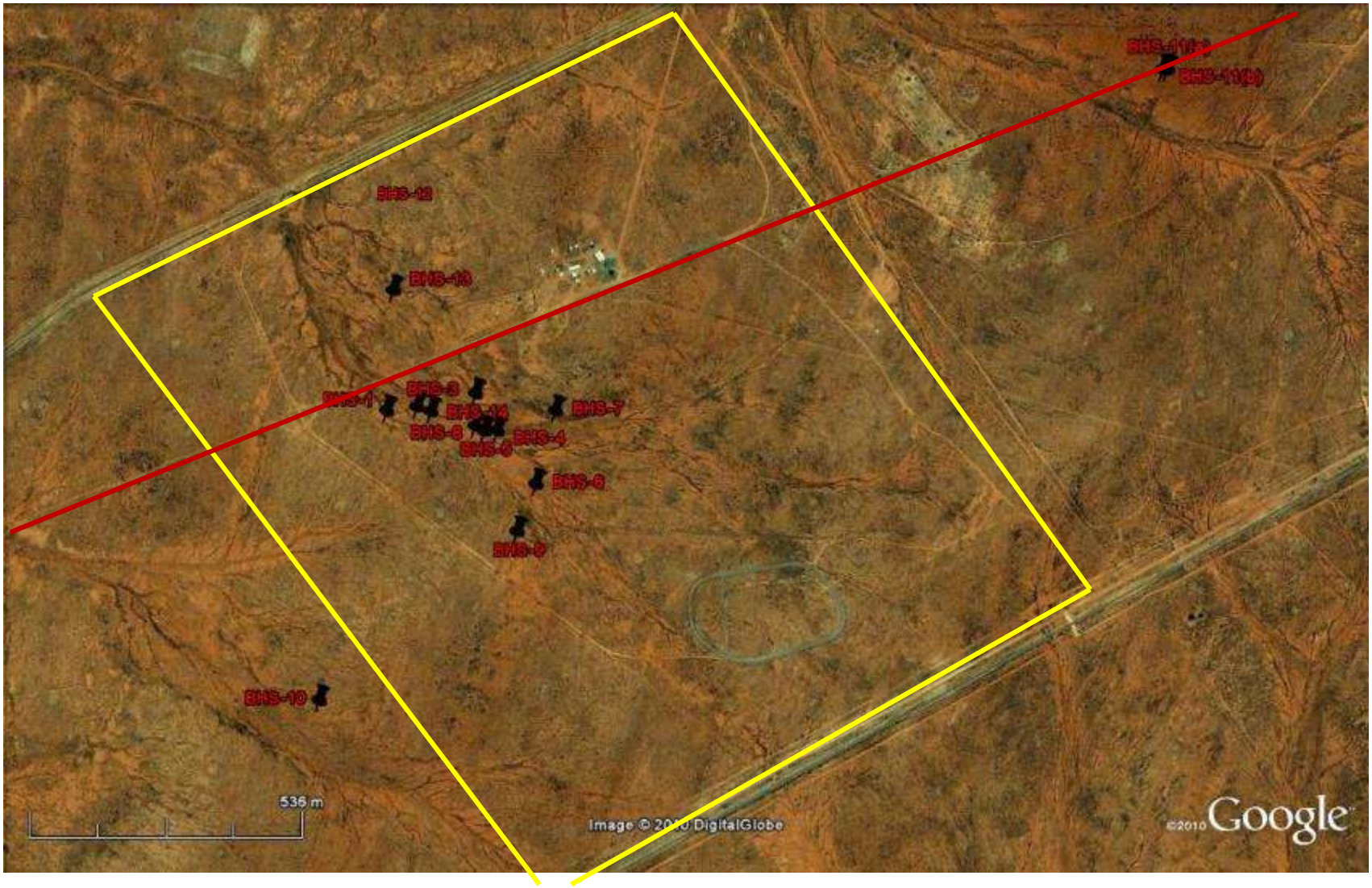


Figure 6: Location of Aboriginal sites identified within the study area (Base map source: Google Earth.app)

BHS-3 (Broken Hill Solar - Site #3)

Site type: An isolated find/ Single artefact (see **Plate 14**)

GPS Coordinates: 54 J 053 6563 E 6460950 N

Location of site: BHS-3 lies approximately 30m East of BHS-2 at a bearing of about 113°. The isolated artefact is situated on an exposed alluvial fan/claypan area within a sparse open chenopod shrubland (Figure 5.2).

Description of site: This site is comprised of a single small translucent quartz flake of dimensions: L=23mm x W=11mm x T=3mm.

BHS-4 (Broken Hill Solar Site # 4)

Site type: An isolated find/ single artefact (see **Plate 15**).

GPS Coordinates: 54 J 053 6692 E 646 0937 N

Location of site: BHS-4 lies approximately 135m east of BHS-3 at a bearing of 105°. It is situated in an exposed alluvial fan washout area less than 10 m east of a small gully/ephemeral channel (Figure 5.2).

Description of site: This site consists of one small silcrete flake with the following linear dimensions: L =16.03 mm x W=15.22 mm x T= 7.33 mm. The flake has a platform length of 11.21 mm and a platform width of 1.32 mm. The flake exhibits 5/6 negative flake scars on its ventral surface and has a feather termination. The silcrete from which it has been manufactured is milky beige in colour, and though of a generally fine-grained texture it does have some coarse inclusions.

BHS-5 (Broken Hill Solar – Site #5)

Site type: An isolated find/ Single artefact (see **Plate 16**)

GPS Coordinates: 54 J 053 6667 E 6460912 N

Location of site: BHS-5 lies approximately 25m west of BHS-4 at a bearing of 270°. It lies on an exposed alluvial fan washout area about 5 m west of the channel bank of a small ephemeral gully.

Description of site: This site comprises a single small silcrete flake of dimensions: L= 27.69mm x W=14.11mm x T=5.61mm. The flake has a platform length of 10.24mm and platform width 5.09mm. The flake has retouch on its ventral margins and a feather termination. The artefact is made of a yellow, generally fine grained silcrete with some coarse inclusions.

BHS-6 (Broken Hill Solar – Site #6)

Site type: An isolated find/ Single artefact (see **Plate 17**).

GPS Coordinates: 54 J 053 6767 E 6460809 N

Location of site: This site is situated about 140m southeast of BHS-5 at a bearing of 137°. The site is within a large area of exposed alluvial fan/claypan in between two incising ephemeral channels that intersect each other approximately 20 m to the north of the site.

Description of site: This site is constituted by one small beige chert artefact. The artefact is broken and is without its distal portion. It has dimensions of L=11.49 x W=16.02 x T=5.85. It has a platform length of 4.41mm and a platform width of 2.95mm.

BHS-7 (Broken Hill Solar – Site #7)

Site type: An isolated find/ Single artefact (see **Plate 18**).

GPS Coordinates: 54 J 053 6805 E 6460788 N

Location of site: BHS-7 is located approximately 140m north of BHS-6, and approximately 120m east of BHS-4. It lies in a large area of exposed alluvial fan/ claypan about 20m to the west of a narrowly incising gully.

Description of site: This site is constituted by a single milky white/ beige silcrete artefact. The artefact is broken and is retains its proximal portion only. It has dimensions of L=19.63 mm x W=16.0 mm x 5.85 mm. It has a platform length of 7.64mm and a platform width of 3.93 mm.

BHS-8 (Broken Hill Solar – Site #8)

Site type: An isolated find/ Single artefact (see **Plate 19**).

GPS Coordinates: 54 J 053 6649 E 6460922 N

Location of site: BHS-8 lies about 25m northwest of BHS 5 immediately adjacent to the west bank of a narrow incising ephemeral channel. It lies at the northern edge of a small gully that drains eastward towards this main ephemeral channel. It lies on an un-vegetated and exposed alluvium within a sparse chenopod shrubland.

Description of site: This site is constituted by one very small banded chert flake. The flake is beige in colour with lighter cream, horizontal banding. The flake exhibits retouch on its ventral surface and has an incomplete 'snapped' feather termination. The artefact has dimensions of L=15.64 mm x W=10.71 mm x T= 2.93 mm. It has a platform length of7.64mm and a platform width of 3.93mm.

BHS-9 (Broken Hill Solar – Site #9)

Site type: A quartz artefact scatter (see **Plate 20**).

GPS Coordinates: 54 J 053 6730 E 6460717 N

Location of site: This site is situated in bedrock colluvial deposits in the elevated portion of the study area approximately 90m east of the western boundary fence of the large fenced paddock that surrounds the residential portion of the study area (Figure 5.2).

Description of site: This site is a small, approximately 5 x 8 m milky quartz artefact scatter. It is comprised of about 6 flakes, at least 7 flaked pieces and a number of smaller quartz fragments. Summary details of the 6 quartz flakes are presented in Table 7 below.

Table 7: Artefact Descriptions - BHS-9.

Artefact #	Artefact Type	Material	Comment	Flake Dimensions (LxWxT) mm*	Platform (LxW)mm
1	Flake	Quartz	Whole flake with feather termination and retouch on ventral surface	38 x 22 x 9	14 x 7
2	Flake	Quartz	Broken flake, proximal end only	18 x 21 x9	14 x7
3	Flake	Quartz	Whole flake with feather termination	19 x 15 x 5	5 x 13
4	Flake	Quartz	Whole flake	21 x 16 x 6	NR**
5	Flake	Quartz	Whole flake	29 x 20 x 6	NR
6	Flake	Quartz	Whole flake with hinge termination	25 x 32 x 9	8x 13

*L=length, W=width, T=thickness **NR=not recorded

BHS-10 (Broken Hill Solar – Site #10)

Site type: An isolated find/single artefact (see **Plate 21**).

GPS Coordinates: 54 J 053 6343 E 6460392 N

Location of site: BHS-10 lies about 570m north of the southwest corner/southern boundary fence of the study area. It lies in an exposed alluvial fan/claypan area that is associated with the large ephemeral channel that marks the western margins of the study area.

Description of site: This site consists of a single broken yellow silcrete flake with negative flake scars on the ventral surface. The artefact has dimensions of L=55mm x W=36mm x T= 15mm. It has a triangular platform of length 18mm and width of 6mm.

BHS-11 (Broken Hill Solar – Site #11)

Site type: A low density, artefact scatter (see **Plate 22**)

GPS Coordinates: 54 J 0537986 E 646 1608 N

Location of site: The site is located east of the main study area in disturbed Crown Reserve. This site lies approximately 70m east of a shallowly incised (0.5-1m deep) ephemeral channel and about 10m south east of Pole #387 in the 222 kV electricity transmission line easement that crosses the crown reserve and continues west into the main study area. The area is vegetated by a sparse chenopod dominated shrubland with occasional emergent shrubs such as *Dodonea spp* to 1m.

Description of site: This site is a low density artefact that comprises three silcrete artefacts in loose association within an approximately 25 x 6 m area. Details of each artefact are provided in Table 8 below:

Table 8: Artefact Descriptions - BHS-11.

Artefact #	Artefact Type	Material	Comment	Flake Dimensions (LxWxT) mm*	Platform (LxW)mm
1	Flake	silcrete	Whole flake with hinge termination and multiple negative flake scar on ventral surface	37 x 35 x12	11 x 6
2	Flake	silcrete	Multiple flake scars on ventral and dorsal services	34 x 47 x13	39 x11
3	Flake	silcrete	Whole flake with hinge termination	12 x 30x 8	6x 15

BHS-12 (Broken Hill Solar – Site #12)

Site type: A low density artefact scatter (see **Plate 23)**

GPS Coordinates: 54 J 0536445 E 646 1385 N

Location of site: In alluvial fan washout/claypan/scald in sparse low chenopod shrubland c. 60m south of the Old Adelaide Road disturbance Corridor and 130m east of the dam in the northwest portion of the study area (see **Plate 24**). Details of each artefact are provided in Table 9 Below.

Table 9: Artefact Descriptions - BHS-12.

Artefact #	Artefact Type	Material	Comment	Flake Dimensions (LxWxT) mm*	Platform (LxW) mm
1	Flaked piece	silcrete	Both distal and proximal ends missing		
2	Whole Flake	silcrete	Whole flake with hinge termination	26 x 20 x4	11 x3
3	Broken Flake	Banded chert	Broken flake with hinge termination	21x14x4	7x 2

BHS-13 (Broken Hill Solar – Site #13)

Site type: An isolated artefact (see **Plate 25**).

GPS Coordinates: 54 J 0536493 E 646 1184 N

Location of site: In exposed alluvial fan washout/claypan in sparse low chenopod shrubland *c*. 180m southeast of the Old Adelaide Road disturbance corridor (see Plate 24).

Description of site: This site comprises a single, pale yellow silcrete flaked piece, with coarse conclusions.

BHS-14 (Broken Hill Solar – Site #14)

Site type: An isolated artefact (see **Plate 26**).

GPS Coordinates: 54 J 0536652 E 646 0984 N

Location of site: In exposed alluvial fan washout claypan/scald in sparse low chenopod shrubland *c*. 110m southeast of the transmission line that transects the study area; and *c.* <10m of the incised ephemeral channel.

Description of site: This site comprises a single pale yellow silcrete flake that exhibits two planes of artefact manufacture. The dimensions of these two planes are provided in Table 10 below silcrete piece of is a low density artefact that comprises three artefacts. Details of each artefact are provided in Table 10 below

Table 10: Planes of artefact at BHS-14

Plane	Artefact Type	Material	Comment	Flake Dimensions (LxWxT) mm*	Platform (LxW)mm
1	Flake	silcrete	Elongate plane	37x24.5x12	9.8x14
2	Flake	silcrete	Perpendicular plane	24x37x12	9x6

5.3 Aboriginal Community Input

Dulcie and Raelene O'Donnell of the Broken Hill Local Aboriginal Land Council actively participated in the field work. In the deflating surfaces of the alluvial clay pans associated with the recorded site BHS-11, Dulcie O'Donnell raised the possibility that hearths associated with baked clay anthills might be discernible. However there was insufficient evidence to confirm the presence of a hearth. Moreover, the archaeological record determined for the study area consists only of isolated finds and/or low density artefact scatters and does not therefore point to any duration to the exploitation of the study area by ancestral Aboriginals.

5.4 Discussion

The archaeological evidence recovered in this survey is consistent with the broader archaeological record of the Broken Hill Complex Bioregion. A preponderance 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. This preponderance is both a function of the lack of available water and its concomitant negative effect on the carrying capacity of this local environment; and the geomorphic processes of wind and water erosion that have acted to reveal such Aboriginal objects in these disturbed contexts.

With 9 isolated Aboriginal objects being identified within the approximately 300 x 180m square area about Transect 2 (Figure 7) it is tempting to (a) combine these objects into a single artefact scatter

site record and/or (b) define this portion of the ephemeral channel as an area of localised archaeological sensitivity. However, the raw artefact density calculation for such an area is only 1.6 x 10^{-4} artefacts/sq.m which increases to 3.7 x 10^{-4} artefacts/sq.m (i.e. 3.6 artefacts/ sq.km) if archaeological visibility and surface exposure is also taken into account. This does not suggest an archaeological signature for this environment beyond the background scatter that is generally expected where Aboriginal people are known to have traversed an area in the past, although it is acknowledged as being higher than the surrounding surveyed areas.

Figure 7: Approximate extent of area of highest artefact density shown in yellow.

5.5 Assessment of Heritage Significance

5.5.1 Introduction

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. Cultural, scientific and public significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area can be identified.

5.5.2 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. Aspects of cultural significance include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of significance may not be in accord with interpretations made by the archaeologist - a site may have low scientific significance but high Aboriginal significance, or vice versa.

The significance of the archaeological sites located within the study area was addressed during the survey with the community representatives, and is further addressed through the consultation process.

5.5.3 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 in view of current archaeological discourse. This type of significance relates to the ability of a site to answer current research questions and is also based on a 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'. Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region? In general terms, any Aboriginal object has the ability to either add to our knowledge about an area's Indigenous history, comment on the technological developments of a people or may act as potential markers for subsurface deposits.

Open Sites

The scientific significance of open sites is extremely variable and dependent upon several factors relating to:

- Preservation: Their integrity and potential to be conclusively proven to be Aboriginal in origin;
- Representativeness: Is this the type of site one may expect in this landscape (i.e. does it relate back to the predictive model)? Do many such sites occur nearby? Etc; and
- Are there artefacts or other sites present (material, types or combinations thereof) that are rare in the area or unusual concentrations/ or rarity for the area?

5.5.4 Public significance

Sites that have public significance do so because they can educate people about the past. By reducing ignorance about why sites are important to the Aboriginal and scientific community, important sites can be protected from ignorant or inadvertent destruction. Educating the public to understand the need for site preservation 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. 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.

Scarred trees are easily appreciated due to their obvious visual manifestation, but unless a scarred tree is in some way outstanding (i.e. located in an area where such site types are rare, a very obvious canoe or toe hold tree or an unusual species to carry scarring), and depending on the condition of the tree, this site type is usually assessed as having moderate-low public significance.

Artefact sites and / or PADs are generally difficult for the lay-person to appreciate without interpretative aids.

5.6 Assessed significance of the recorded sites

5.6.1 Cultural significance

The cultural significance of the Aboriginal objects identified during this study to the Local Aboriginal community has been requested throughout the consultation process. Discussions with the Chair of the Broken Hill Local Aboriginal Land Council, Mrs Maureen O'Donnell, points to the view that stone artefacts wherever deposited represent the *in situ* use of that landscape by ancestral Aboriginals at some-time in the past. The Aboriginal field participants did not indicate that there was any known site or area within the study area that held specific cultural significance for the wider Aboriginal community. Nevertheless it was noted that the highly significant Aboriginal Place "The Pinnacles" was a dominant feature in the western horizon of the study area, and the use of the landscape of the study area by Aboriginal people was expected given its close relative proximity to such an important site.

5.6.2 Scientific significance

The scientific/archaeological significance of all Aboriginal archaeological materials recorded within the study area is considered to be low. Non-complex isolated stone artefacts and/or low density stone artefact scatters were the only Aboriginal object types identified across the study area. These Aboriginal object types are common in local and regional contexts. Likewise, as is also common in local and regional landscape contexts, the majority of the identified isolated finds/artefact scatters were found in close proximity to ephemeral channels. Moreover, the raw materials used to manufacture these artefacts (quartz, silcrete and chert) are commonly used within the local region, and the artefact types identified do not represent a complex and locally or regionally significant artefact assemblage. Finally, the deflating nature of the landscape in which the artefacts are situated implies that they are no longer within their original depositional context. This means (a) that there is very little likelihood of them being associated with intact stratigraphic deposits and/or (b) of them yielding information that can inform us of the nature, extent and patterning of past Aboriginal occupation of the study area.

5.6.3 Public significance

The public significance and/or educative value of the Aboriginal archaeological materials recorded within the study area is considered to be low to moderate. In their current context they will remain subject to the vagaries of geomorphic processes such that wind and/or water effects may cause the objects to be non-discernible in a short period of time. In addition, the relative low density and low complexity of the artefact assemblage provides little inducement 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. Alternatively the salvage and transfer of these Aboriginal objects to the Local Aboriginal Land Council offers some opportunity that the objects can be used to reinforce Aboriginal cultural traditions and their association and linkages to the landscape about Broken Hill. This is especially the case if the salvaged objects are accompanied by a report detailing the landscape context from which they have been retrieved.

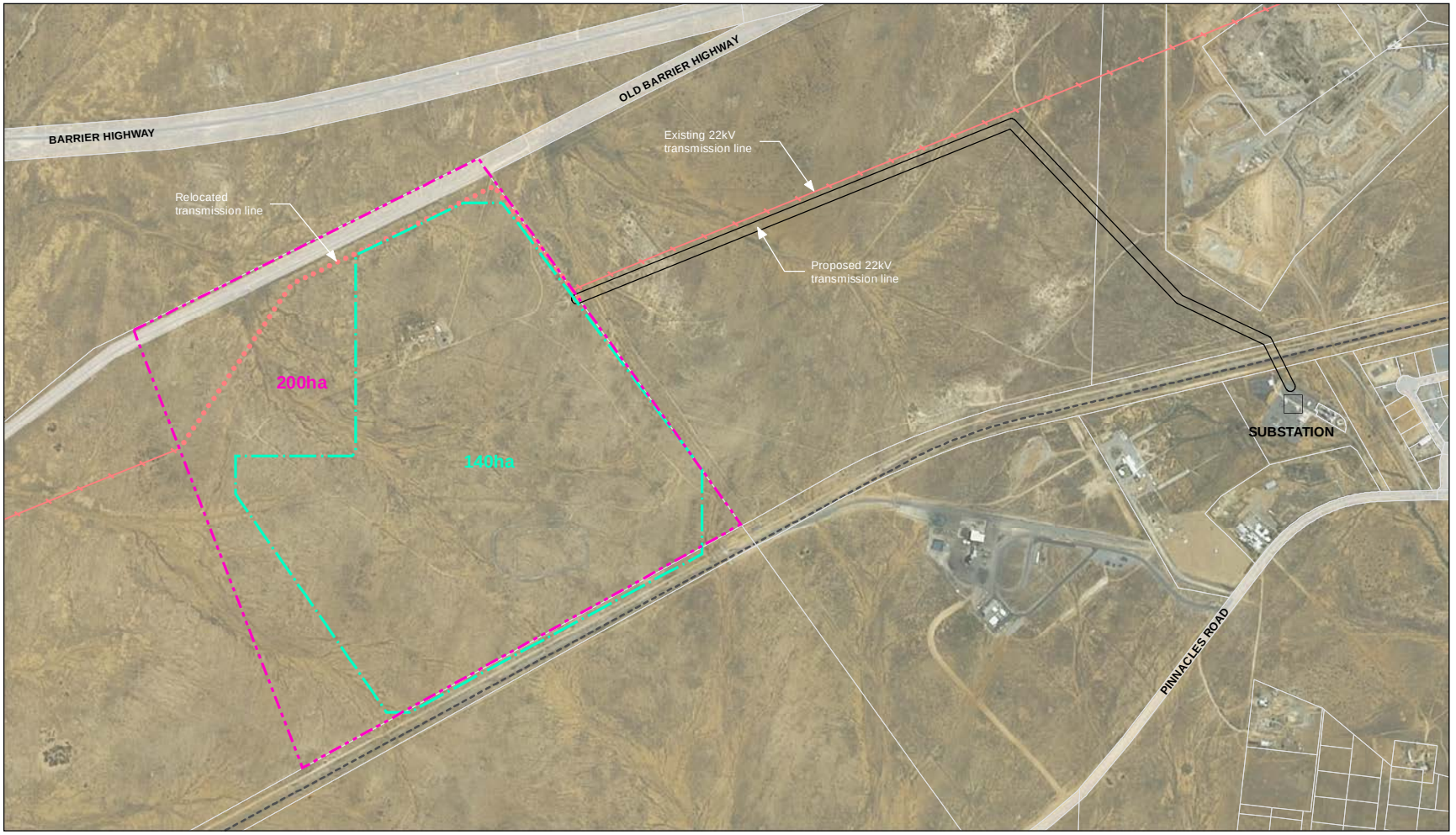


Figure 7 Proposed Impact Footprint for the Broken Hill Solar Project

SINCLAIR KNIGHT MERZ

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Spatial Team - Prepared by : JC
Checked by : JL

6 Project Impacts and Management

6.1 Likely impacts on Indigenous Heritage From the Proposal

The primary issues in terms of Project impacts will be from the following:

- Construction works within the Project Site. Impacts are to occur across the area encompassed by the green line in **Figure 7**. This will impact seven Aboriginal sites (BHS4-9 and 14).
- The ETL construction is likely to impact one Aboriginal site. This impact could be ameliorated by pole placement and access to the ETL being controlled in relation to the artefacts of site BHS-11.
- Six sites (BHS1-3, 10, 12-13) are avoided by project impacts, but care will be needed to ensure their protection through both construction and operational phases of the solar plant.

Site-specific impacts are summarised in **Table 11.**

6.2 Management Options

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance, as well as the likely impacts of the proposed development. Section 5.6 describes the significance of the recorded sites from a cultural, scientific and public-interest perspective, while Section 6.1 lists the sites that could be impacted by the project. The following management options are based on general principles, in terms of best practice and desired outcomes. Specific management options for the identified Aboriginal sites based on known site impacts are presented in Section 6.2.1

General processes considered in management determination are as follows:

Avoid impact to sites by altering the development proposal. This is the optimal way to manage potential impacts and obviously results in a conservation outcome. If this can be done, then a suitable curtilage around sites must be determined so as to ensure their protection both during the short term construction phase of development and in the long term use of the area. If the project design is altered, care must be taken to ensure that sites previously assessed as not impacted, remain so. This may be facilitated where necessary through the fencing off of sites during construction so as to minimise inadvertent, short term impacts.

If impact is unavoidable, the AHIP[4] permits that are required for impacts to Aboriginal heritage under the *NP&W Act* are not required as the AGL Solar project is being assessed under Part 3A of the *EP & A Act.* This notwithstanding, the spirit of site protection and management in the face of impacts remains the same. In place of a permit under the NPW Act, a Statement of Commitments (SoC) in terms of heritage management is prepared. This SoC forms the basis for the Minister's approval which would usually contain one or more conditions, including a requirement for the preparation of an Aboriginal Heritage Management Plan (AHMP), to be developed in consultations with the Aboriginal community stakeholders and often OEH, with which the Proponent would be required to operate in accordance. These conditions include similar checks and balances as required by the AHIP process,

[4] Aboriginal Heritage Impact Permit

such as test excavation programmes or site destruction / mitigation development etc., however, without the need to obtain permits.

The AHMP will include measures for site conservation, as well as detailing methods for the management of sites to be impacted. The management will depend on many factors including the assessed significance of the sites. Sites of moderate to high significance and/or potential may require either test or salvage excavation, or more detailed recording, as part of the AHMP. Sites of low significance may be removed / destroyed with no further archaeological assessment being required, or with an approved salvage / monitoring programme. The local Aboriginal communities may wish to collect or relocate artefacts, whether temporarily or permanently, and such issues are also required to be covered off in the AHMP.

6.2.1 Proposed Management of Aboriginal heritage sites for the AGL Solar Project

Seven (7) of the fourteen (14) recorded Aboriginal sites are located within the proposed impact footprint for the AGL Solar Project. In terms of the management proposed for these sites, it is relevant to recall that the majority of these 'sites' are isolated artefacts located primarily in a cluster near the creekline running through the centre of the study area. Overall their density is low and the landscape deflated.

The specific management recommendations detailed below in sections 6.2.1.1-6.2.1.3 should be the subject of consultation with the Aboriginal registered stakeholders for this project, both through review of this draft report and subsequent to approval within the development of the project AHMP.

Table 11: Site specific impacts and management summary.

Site Number	Impact(s)	Recommended Management
BHS-1	Outside impact footprint	None required. Fence site off if it is close to project impacts
BHS-2	Outside impact footprint	None required. Fence site off if it is close to project impacts
BHS-3	Outside impact footprint	None required. Fence site off if it is close to project impacts
BHS-4	Photovoltaic unit construction	Isolated find. Collect and relocate
BHS-5	Photovoltaic unit construction	Isolated find. Collect and relocate
BHS-6	Photovoltaic unit construction	Isolated find. Collect and relocate
BHS-7	Photovoltaic unit construction	Isolated find. Collect and relocate
BHS-8	Photovoltaic unit construction	Isolated find. Collect and relocate
BHS-9	Photovoltaic unit construction	Open artefact scatter. Collect and relocate artefacts.
BHS-10	Outside impact footprint	None required. Fence site off if it is close to project impacts
BHS-11	ETL	Open artefact scatter. Collect and relocate artefacts if necessary. It should be possible to avoid some portions of this site due to the intermittent nature of the ETL impacts.
BHS-12	Outside impact footprint	None required. Fence site off if it is close to project impacts
BHS-13	Photovoltaic unit construction	Isolated find. Collect and relocate
BHS-14	Photovoltaic unit construction	Isolated find. Collect and relocate

6.2.1.1 Management of sites BHS4-9 and 14

These seven sites are predominantly isolated finds, with one small artefact scatter. The clustering of these finds along the creek line indicates deflated, low density evidence of Aboriginal occupation. The management of these objects is best undertaken through collecting them and moving them out of harm's way or facilitating the Broken Hill LALC to have Care and Control of these artefacts in perpetuity. The fate of the artefacts would need to be decided by the Aboriginal community through

the development of the AHMP for the project, which would occur after the approval process is complete.

6.2.1.2 Management of Sites BHS-11

This site is a deflating artefact scatter that may have some hearth /ground oven material in association. The level of deflation makes it challenging to be sure of this and there were differing opinions during survey. Management of the surface manifestations of this site in reference to the ETL construction should be undertaken as follows:

1. In the company of a qualified Aboriginal sites officer or archaeologist, the Proponent should peg out the impact footprints of the ETL in the vicinity of the site.
2. If at all possible the ETL poles and access track should be sited so as to span the artefactual material.
3. If some surface artefacts cannot be avoided then collection / removal is the appropriate management.

6.2.1.3 Management of Site BHS1-3 and 10-13

These sites are currently avoided by the project impacts. Care should be taken to ensure that changes to construction footprints do not endanger these sites into the future. Due to the proximity of the majority of these sites to the project impacts, the Proponent should ensure that they are fenced and that all staff and contractors are aware of the location of the site and its legislative protection under the NPW Act 1974.

6.3 Relevant Legislation

6.3.1 State legislation

6.3.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act 2005 is founded on the Environmental Planning and Assessment Act 1979 that requires environmental impacts, including cultural heritage, to be considered at a land-use planning and decision making level. Essentially this provides a new method for project assessment that places major infrastructure projects, or those deemed to be of state significance as defined in Schedule 1 of the State Environmental Planning Policy (Major Development) 2005, under Part 3A of the Act.

Under the EP&A Act Aboriginal heritage is protected in three different ways:

- Through planning instruments such as Regional Environmental Plans (REPs) and Local Environmental Plans (LEPs). Such plans outline permissible land use as well as identifying potential constraints. Section 112 (1) of the EP & A Act delineates that no approval for either prescribed developments or developments likely to significantly affect the environment, may be granted without prior appropriate environmental impact assessment.
- Section 90 of the Act (Part 4, Division 5) lists impacts to the environmental resource, including cultural heritage, which must be considered before development approval is granted.
- All State Government agencies acting as determining authorities on environmental issues must consider a range of community and cultural factors, including Aboriginal heritage, in their decision-making process. The factors to be considered in such assessments are set out in the EP&A Regulations (1980), Part VII.

Under Section 75U of *The Environmental Planning and Assessment Act 2005 (EP&A Act),* if the current project is granted project approval under Part 3A of the EP&A Act, the following approvals, which may have otherwise been relevant, will not be required to carry out the Project:

- Heritage Act 1977: Disturbance to an item listed on the State Heritage Register or Interim Heritage Order – Excavation Permit; and
- National Parks and Wildlife Act 1974: A Section 90 consent to destroy objects.

Application to the Study Area

The current proposal to develop a Solar Project at Broken Hill is being assessed under Part 3A of the *EP&A Act*. As such, destruction of or disturbance to any of the sites within the project impact footprint would not require Section 90 Aboriginal Heritage Impact Permits under the NP&W Act.

Aboriginal sites under Part 3A are managed through the development of an Aboriginal Heritage Management Plan (AHMP), which is prepared in consultation with the Aboriginal registered stakeholders.

6.3.1.2 National Parks and Wildlife Act 1974

Amended during 2010, the *National Parks and Wildlife Act 1974* provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the Act (S.5), an Aboriginal object is defined as: any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises New South Wales, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the *National Parks and Wildlife Act 1974* as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

As of 1 October 2010, it is an offence under Section 86 of the *National Parks and Wildlife Act 1974* to 'harm or desecrate an object the person knows is an Aboriginal object'. It is also a strict liability offence to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the Act provides a series of defences against the offences listed in Section 86, viz.:

- The harm was authorised by and conducted in accordance with the requirements of an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the Act;
- The defendant exercised 'due diligence' to determine whether the action would harm an Aboriginal object; or
- The harm to the Aboriginal object occurred during the undertaking of a 'low impact activity' (as defined in the regulations).

Under Section 89A of the Act, it is a requirement to notify the DECCW Director-General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered with the NSW DECCW on the Aboriginal Heritage Information Management System (AHIMS).

Application to the Study Area

The current Proposal is being assessed under Part 3A of the *EP&A Act*. As such, destruction of or disturbance to any of the sites within the project impact footprint would not require Section 90 Aboriginal Heritage Impact Permits under the *NP&W Act.*

6.3.2 Commonwealth legislation

6.3.2.1 Aboriginal and Torres Strait Islander Heritage Protection Amendment Act 1987

The Aboriginal and Torres Strait Islander Heritage Protection Amendment Act of 1987 is a Federal act administered by the Aboriginal and Torres Strait Islander Commission and provides protection for Aboriginal heritage in circumstances where such protection is not available at a state level. This Act comes under Commonwealth jurisdiction which means that it can override state and territory provisions.

6.3.2.2 Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a national framework for the protection of matters of national environmental significance and the conservation of Australia's biodiversity. Under the EPBC Act, "environment" includes:

- ecosystems and their constituent parts, including people and communities;
- natural and physical resources;
- the qualities and characteristics of locations, places and areas;
- heritage values of places; and
- the social, economic and cultural aspects of a listed item.

Recently, Australia has changed the legislation that protects its national heritage places. Three new laws came into effect on January 2004, which provide changes that offer greater legal protection under the existing Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and repeal the Australian Heritage Commission Act 1975 .

The three new Acts are discussed in the following sections.

6.3.2.3 The Environment and Heritage Legislation Amendment Act (No.1) 2003

This Act amended the EPBC Act to include 'national heritage' and protect listed places to the fullest extent under the Australian Constitution. Under the new system, National Heritage joins six other important 'matters of national environmental significance' (NES matters) already protected by the EPBC Act. The Environment and Heritage Legislation Amendment Act (no.1) 2003 also establishes the National Heritage List which records places with outstanding natural and cultural heritage values that contribute to Australia's National identity; and the

Commonwealth Heritage List which comprises the natural, Aboriginal and historic places owned or managed by the Commonwealth.

6.3.2.4 The Australian Heritage Council Act 2003

This Act establishes a new independent heritage advisory body to the Minister for the Environment and Heritage, the Australian Heritage Council (replacing the Australian Heritage Commission established under the Australian Heritage Commission Act 1975) and retains the Register of the National Estate (RNE). The RNE was also established under the Australian Heritage Commission Act 1975 which defined it as a register of those places being components of the natural environment of Australia, or the cultural environment of Australia, that have aesthetic, historic, scientific or social significance or other special value for future generations, as well as for the present community. Listings on the RNE are not legally binding but provide widely acknowledged recognition of the cultural value of the listed place or item.

Listing of an item or place on the RNE has certain implications for how Commonwealth agencies may deal with an item.

6.3.2.5 The Australian Heritage Council (Consequential and Transitional Provisions) Act 2003

This Act repeals the Australian Heritage Commission Act, amends various Acts as a consequence of this repeal and allows for the transition period, whilst the National and Commonwealth Heritage Lists are finalised. During this transition period the Register of the National Estate will act in conjunction with the formative National and Commonwealth lists to provide full coverage for items already identified as having cultural heritage significance.

Approval under the EPBC Act is required if an action is proposed that will have, or is likely to have, a significant impact on the National Heritage values of a National Heritage place and/or any other NES matter. This action must be referred to the Australian Government Minister for the Environment and Heritage. The Minister will decide whether an action will, or is likely to, have a significant impact on a matter of national environmental significance.

The heritage provisions of the EPBC Act allow for a transition period whilst the National and Commonwealth Heritage Lists are finalised. During this transition period the Register of the National Estate acts in conjunction with the formative National and Commonwealth lists to provide full coverage for items already identified as having cultural heritage significance.

Application to the Study Area – Commonwealth Legislation

No items within the Study Area are listed on the Register of the National Estate, the National Heritage List or the Commonwealth Heritage List. As no matters of Commonwealth heritage significance are located within the Study Area, the Commonwealth legislation listed above has no bearing on the current proposal.

7 Recommendations

Under Section 89A of the *NPW Act* (1974 as amended) the Director General of the NSW DECCW must be notified of the location of all Aboriginal sites recorded under any auspices. As a professional in the field of cultural heritage management it is the responsibility of OzArk EHM to ensure this process is undertaken. To this end it is noted that fourteen (14) sites were recorded within the Study Area.

The appropriate site cards for these fourteen sites have been forwarded to DECCW for registration on the AHIMS database.

The following recommendations are made on the basis of:

- Legal requirements under the terms of the *National Parks and Wildlife Act of 1974* (as amended) whereby it is illegal to damage, deface or destroy an Aboriginal relic/object without the prior written consent of the Director, DECCW or approval from the Director of the DoP;
- The findings of the current investigations undertaken within the study area; and,
- The interests of the local Aboriginal Traditional Owners, the Broken Hill Local Aboriginal Land Council and the Indigenous community.

It is recommended that:

5. Fourteen (14) Indigenous sites were recorded during the heritage survey (BHS-1 to BHS-14). All are located within or in close proximity to the Project Site. Management of these sites should be the subject of further consultation with the Aboriginal community stakeholders for this project through the formulation of an Aboriginal Heritage Management Plan (AHMP), should Project Approval be received.
6. The basis for site management in the AHMP should be as follows:
    a. Sites BHS-4-9 and 14 are located within the Impact Footprint for the photovoltaic units. These seven sites are predominantly isolated finds, with one small artefact scatter. The management of these objects is best undertaken through collecting them and moving them out of harm's way or facilitating the Broken Hill LALC to have Care and Control of these artefacts in perpetuity. The fate of the artefacts would need to be decided by the Aboriginal community through the development of the AHMP for the project, which would occur after the approval process is complete.
    b. Site BHS-11 is a deflating artefact scatter that may have some hearth /ground oven material in association. Management of the surface manifestations of this site in reference to the ETL construction should be undertaken as follows:
        i. In the company of a qualified Aboriginal sites officer or archaeologist, the Proponent should peg out the impact footprints of the ETL in the vicinity of the site.
        ii. If at all possible the ETL poles and access track should be sited so as to span the artefactual material.
        iii. If some surface artefacts cannot be avoided then collection / removal is the appropriate management.

c. Sites BHS-1-3,10 and 11-12 are currently avoided by the project impacts. Care should be taken to ensure that changes to construction footprints do not endanger these sites into the future. Due to the proximity of the majority of these sites to the project impacts, the Proponent should ensure that they are fenced and that all staff and contractors are aware of the location of the site and its legislative protection under the NPW Act 1974.

7. The presence of Aboriginal cultural heritage sites significant to the local Aboriginal communities may be appropriately recognised via signage, designed and / or approved by the relevant stakeholders through AHMP process.

8. Should any other 'objects' or other Aboriginal sites be identified during the course of construction, work in that area should cease and the Traditional Owners / BHLALC / DECCW South Western Regional Office be contacted to discuss how to proceed.

9. A copy of the final cultural heritage assessment report for the project should be made available to the registered Aboriginal stakeholders.

10. Two copies of this report (one CD and one hard copy) should be sent to:

    Office of Environment & Heritage
    AHIMS Registrar
    Attention: Cheryl Brown
    PO Box 1967
    Hurstville NSW 1481

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9 Plates

Plate 1: Landform Element 1: A narrowly incised ephemeral channel and associated alluvial fan & washout zone observed during foot traverse of Transect 2. Note the red sandy alluvium within the channel bank and the sparse low chenopod shrubland that is associated with the adjoining alluvial fan (Image, M. Cotter).

Plate 2: A small banded chert flake (BHS-13) (length=15.6mm) found within an exposed clay pan during foot traverse of Transect 17. Note that the flake lies within or above a thin layer of fine sub-angular quartzose gravels (Image, M. Cotter).

Plate 3: Landform Element 2: Textural characteristics of the coarse, quartz dominated gravel colluvium that covers the mid-slope portions of the study area. (Image, P. Hams).

Plate 4: Landform Element 3: Localised bedrock exposure observed in central west portion of the study area. The blue, quartz rich rock is characteristic of the psammite rich Proterozoic metasediments that underpin the geology of the study area. (Image, M. Cotter).

Plate 5: Landform Element 4: Disturbed hill-slope track: This graded sandy track parallels the transmission line easement that runs east to west across the study area (Image, M.Cotter).

Plate 6: The mixed, low (generally < 50cm high) chenopod shrubland that predominates the survey area (Image, M. Cotter).

Plate 7: Due to late winter rains, ephemeral herbs such as Sturt's Desert Pea and some grasses have flourished on the stony rises/ high points within the study area.

Plate 8: The residential dwelling and associated outbuildings situated within the Central northern portion of the study area. The image was taken from the approximate start of Transect 17 facing west. (Image, M. Cotter).

Plate 9: A full dam is situated in the topographic low of the study area immediately south of the Old Adelaide Road. Image taken facing north west (Image, M. Cotter).

Plate 10: The star-picket and wire fence that marks the western boundary of the open paddock that surrounds the house-block. Image facing south east toward the Port Pirie-Broken Hill Railway (Image, M. Cotter).

Plate 11: The culvert beneath the Port Pirie to Broken Hill Railway line. The fence in the foreground marks the southern boundary of the study area. Note the potential for the ephemral channel to increase in width and depth as the metal piping within the culvert concentrates and diverts water along the drainage channel.(Image, M. Cotter).

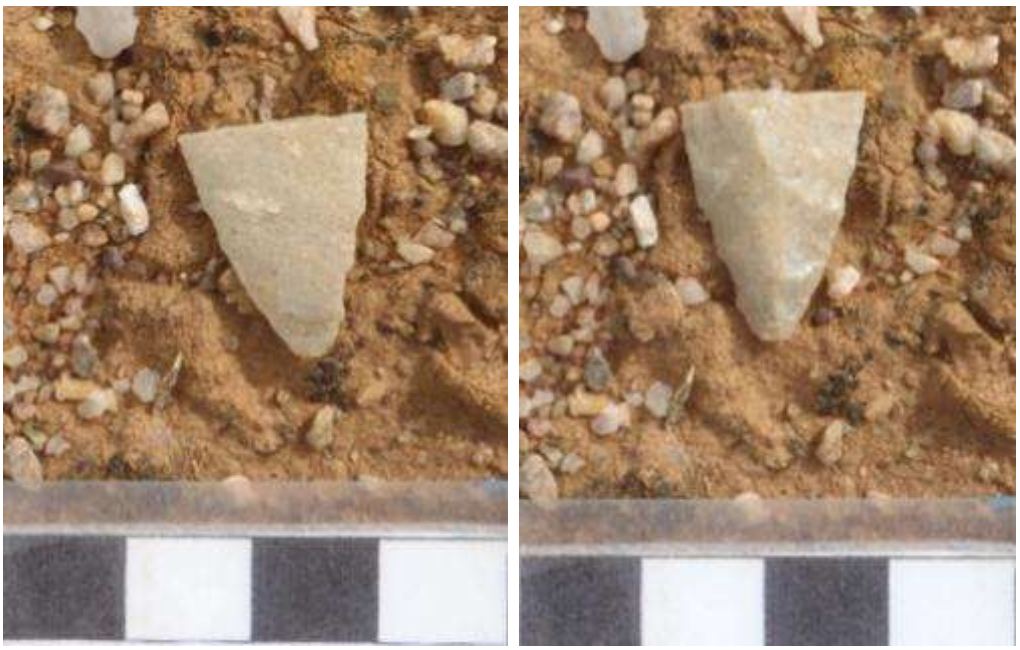


Plate 12. Dorsal and ventral surface of the isolated silcrete artefact that comprises Site BHS-1 (Images M. Cotter).

Plate 13. View facing west-northwest acoss the eroded claypan/alluvial fan outwash area upon which isolated artefact Site BHS-2, a multi-platform silcrete core, was found. (Images M. Cotter).

Plate 14. View facing east-northeast of the eroded alluvial fan upon which isolated find BHS-3, a single retouched quartz flake, was located. (Images P. Hams).

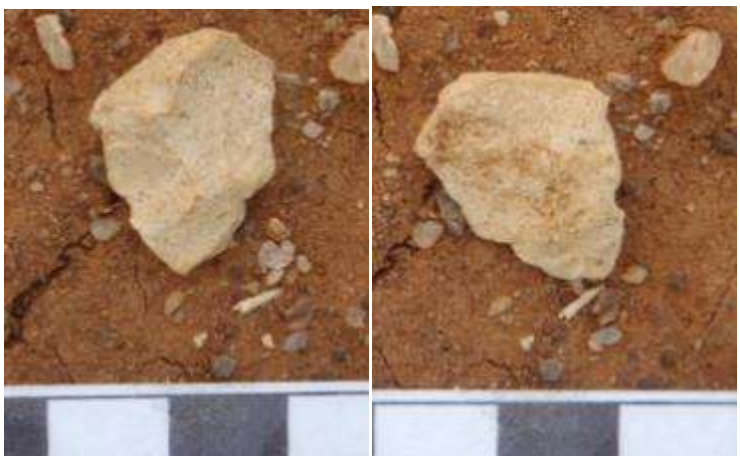


Plate 15: Ventral and dorsal views of isolated find BHS-4 (Images M.Cotter).

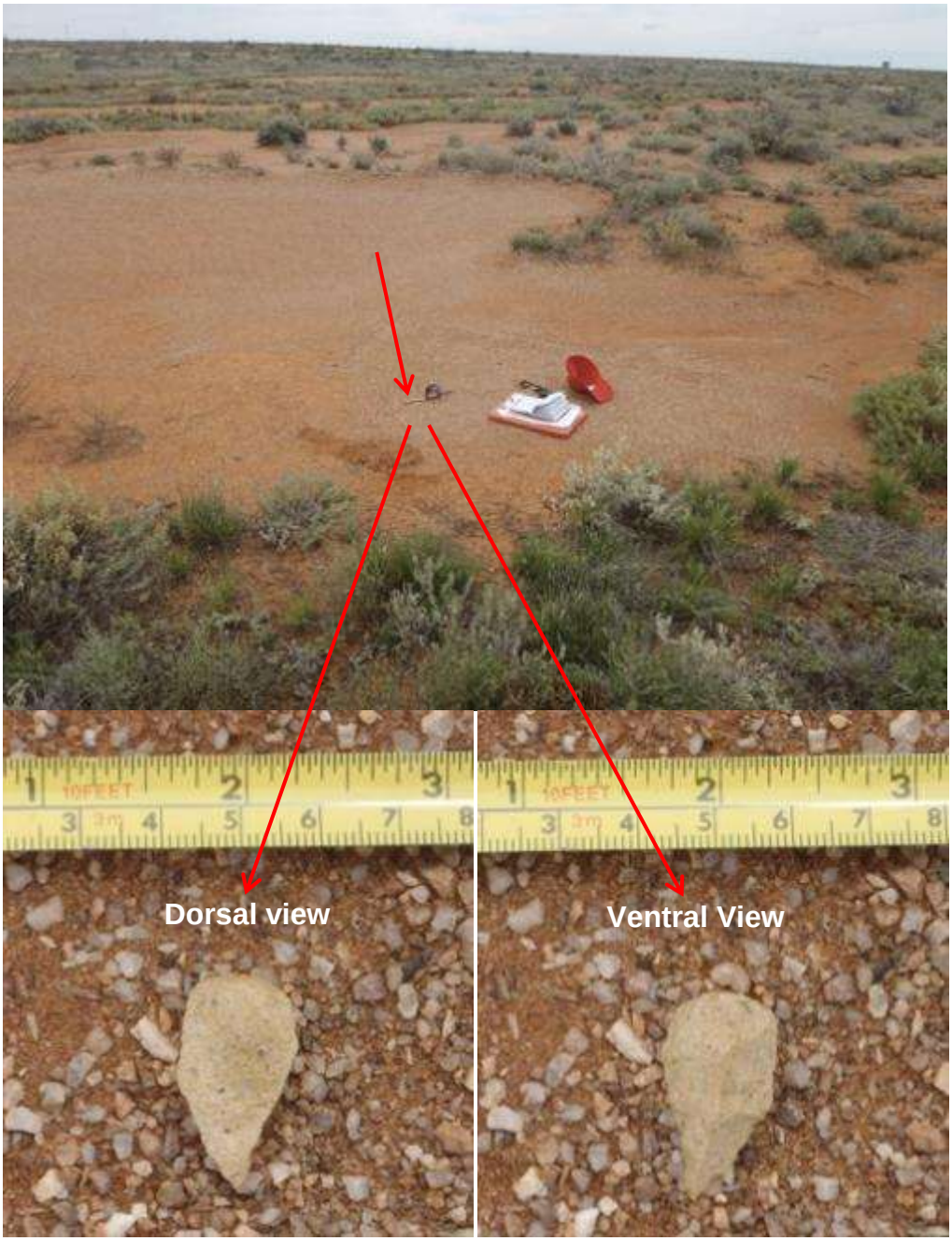


Plate 16: View facing southeast of an area of exposed alluvial floodplain washout upon which an isolated silcrete flake (BH-5), was found. Note that within this relatively broad exposure no other artefacts were identified (Images, M. Cotter).

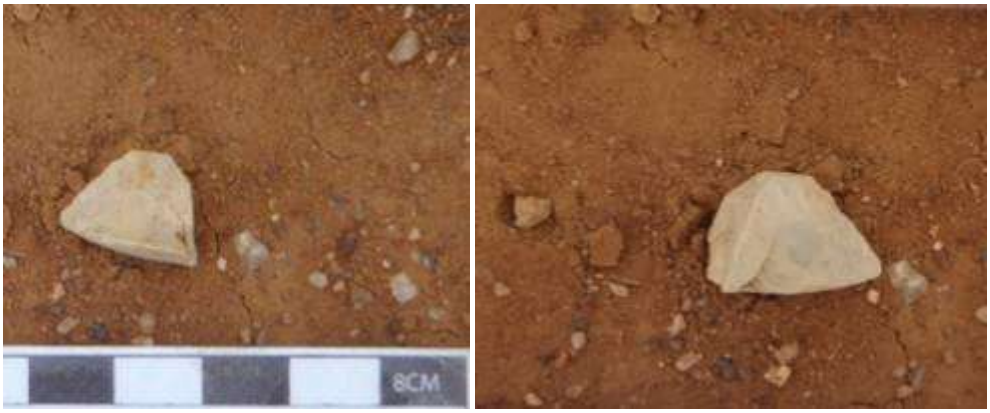


Plate 17: Isolated beige chert artefact identified as BHS-6 (Images, M. Cotter).

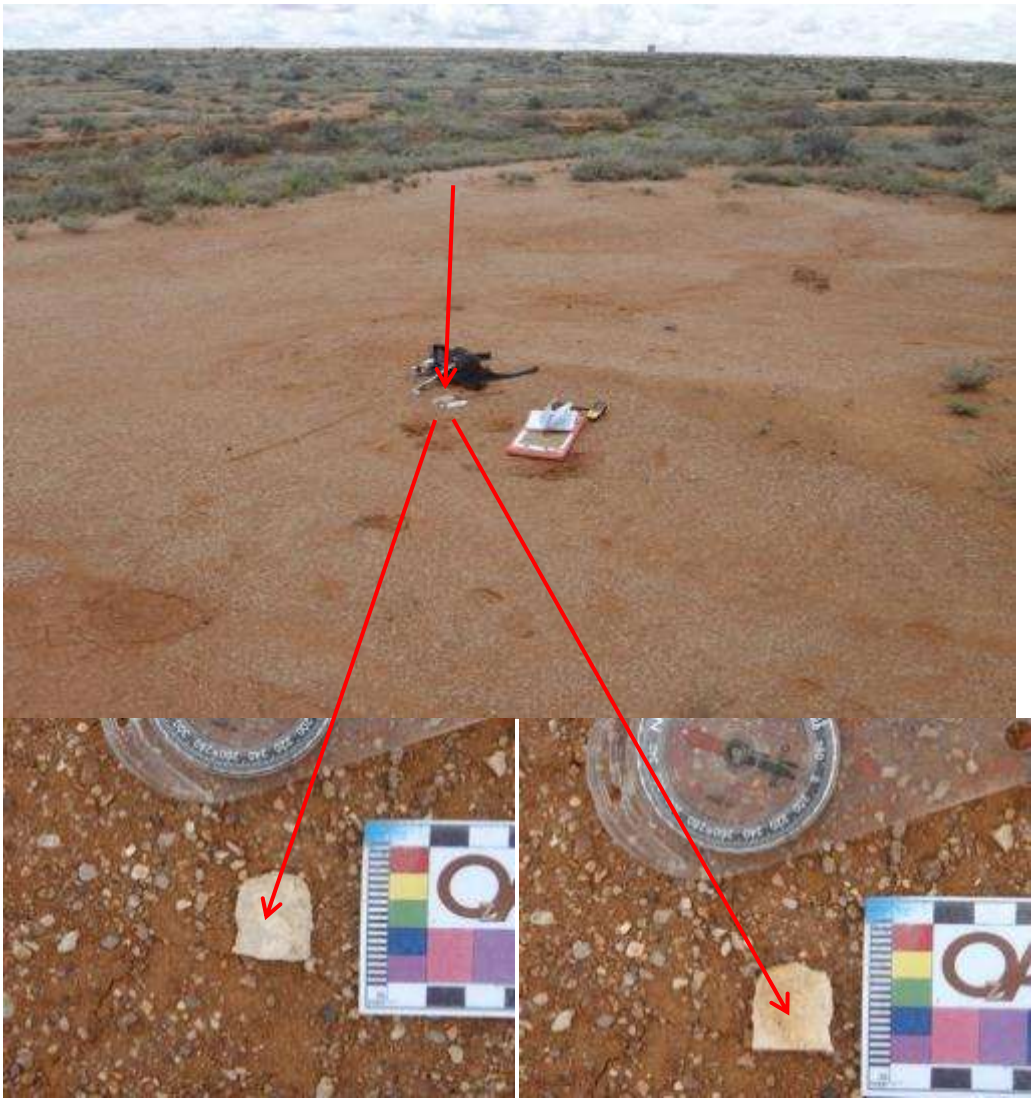


Plate 18: View facing south east of alluvial fan washout area upon which isolated artefact BHS-7, a broken silcrete flake was found. Note the ephemeral channel to the east of this washout area (Images, M. Cotter).

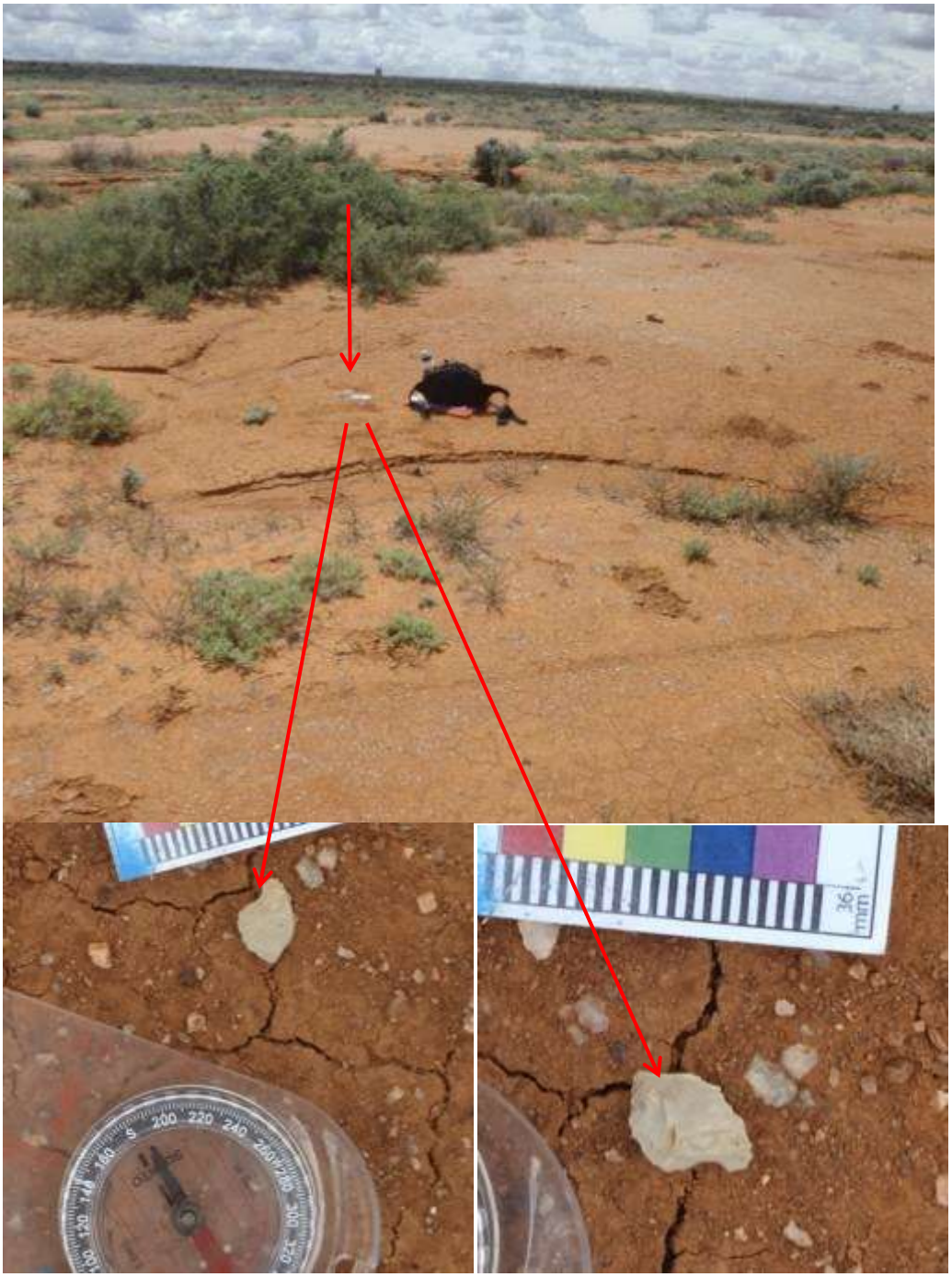


Plate 19: View facing south east of ephemeral channel bank/alluvial fan washout area upon which isolated artefact BHS-8, a small banded chert flake, was found (Images, M. Cotter).

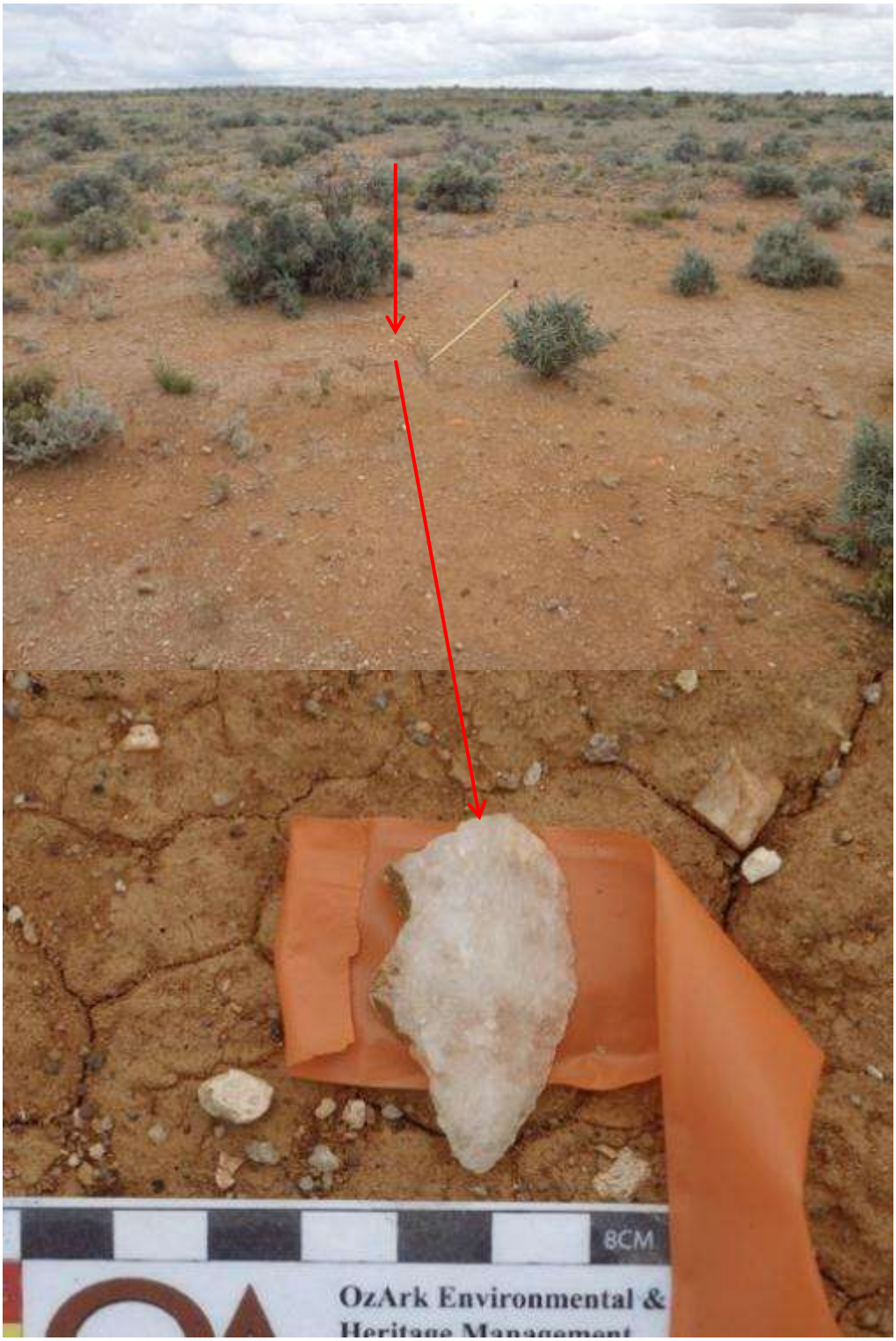


Plate 20: View facing south east of exposed area of mid-slope colluvium and skeletal soil deposit within chenopod shrubland upon which the quartz artefact scatter described as BSH-9 was located. The artefact pictured is Artefact #1 in Table 5.6 (Image, M. Cotter).

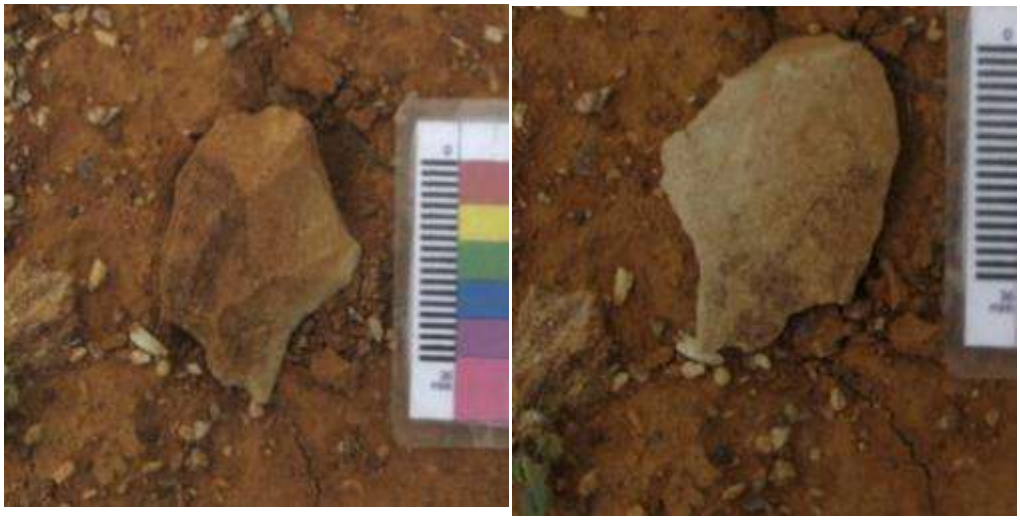


Plate 21: Ventral and dorsal views of isolated find BHS-10 (Images P.Hams).

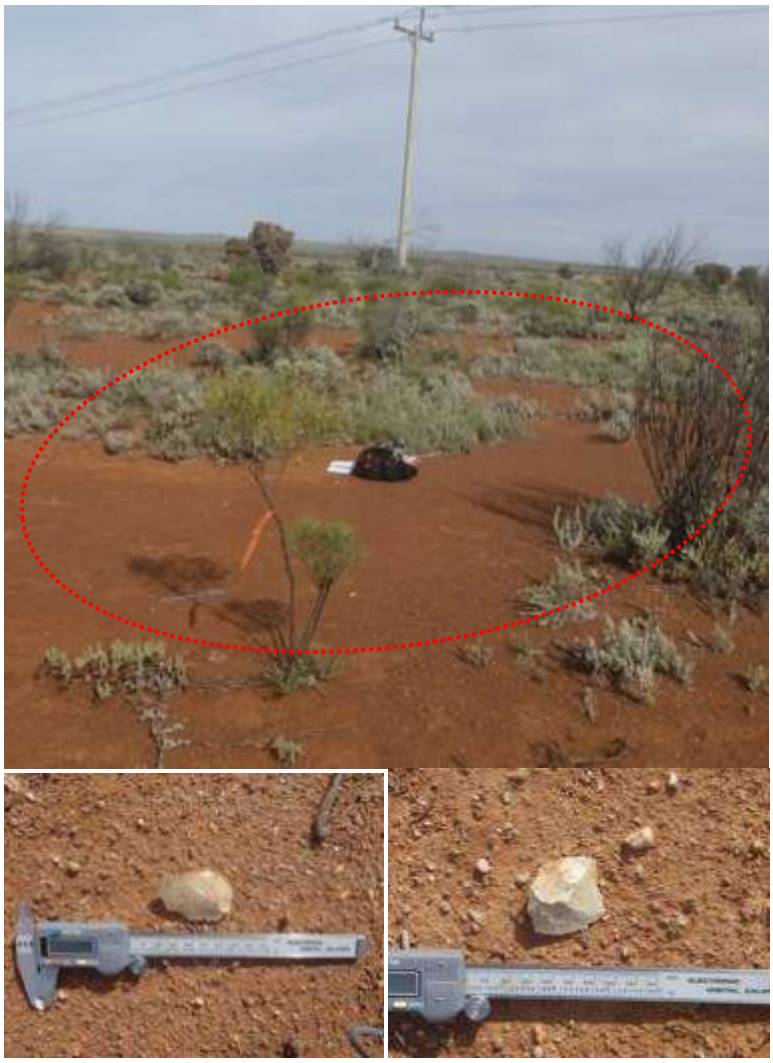


Plate 22 View facing north west of the location of artefact scatter BHS-11 (Images, M. Cotter).

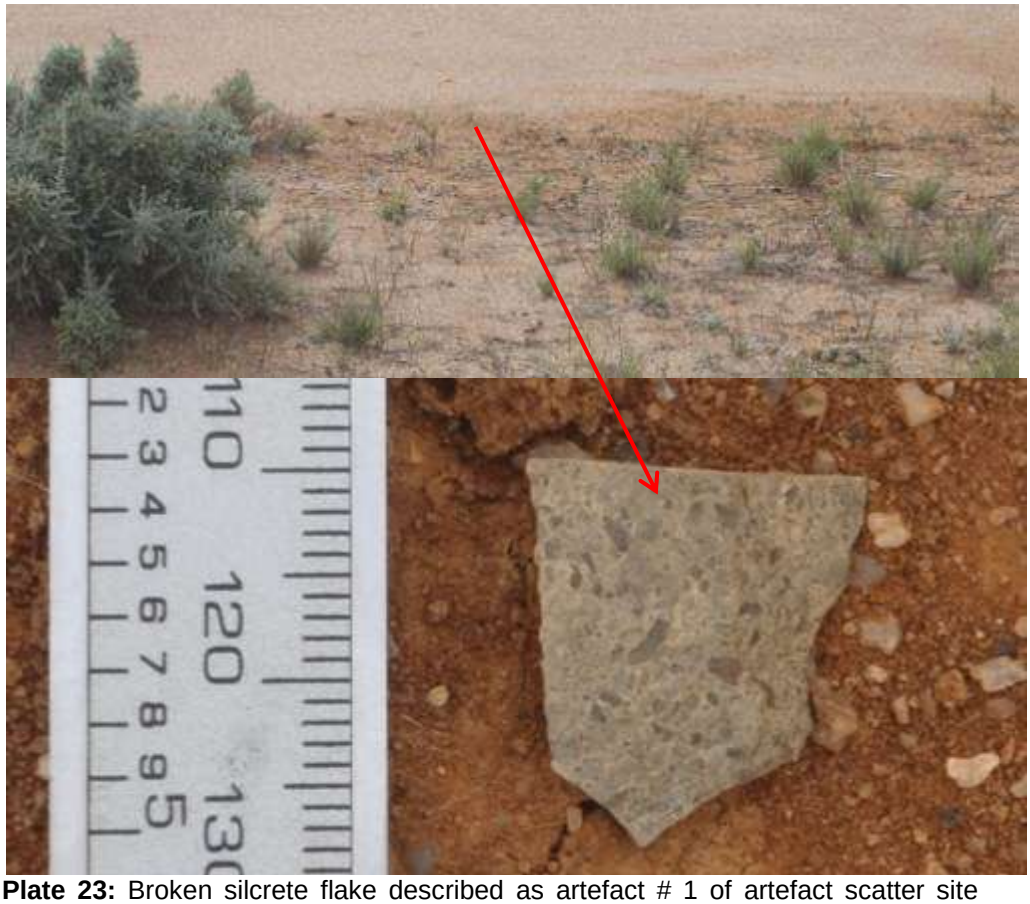


Plate 23: Broken silcrete flake described as artefact # 1 of artefact scatter site BHS-12 (Image M. Cotter).

Plate 24: Within Transect 17: view facing northwest towards dam of low chenopod shrubland on exposed alluvium typical of area within which sites BHS-12 & BHS-13 were located (Image M. Cotter).

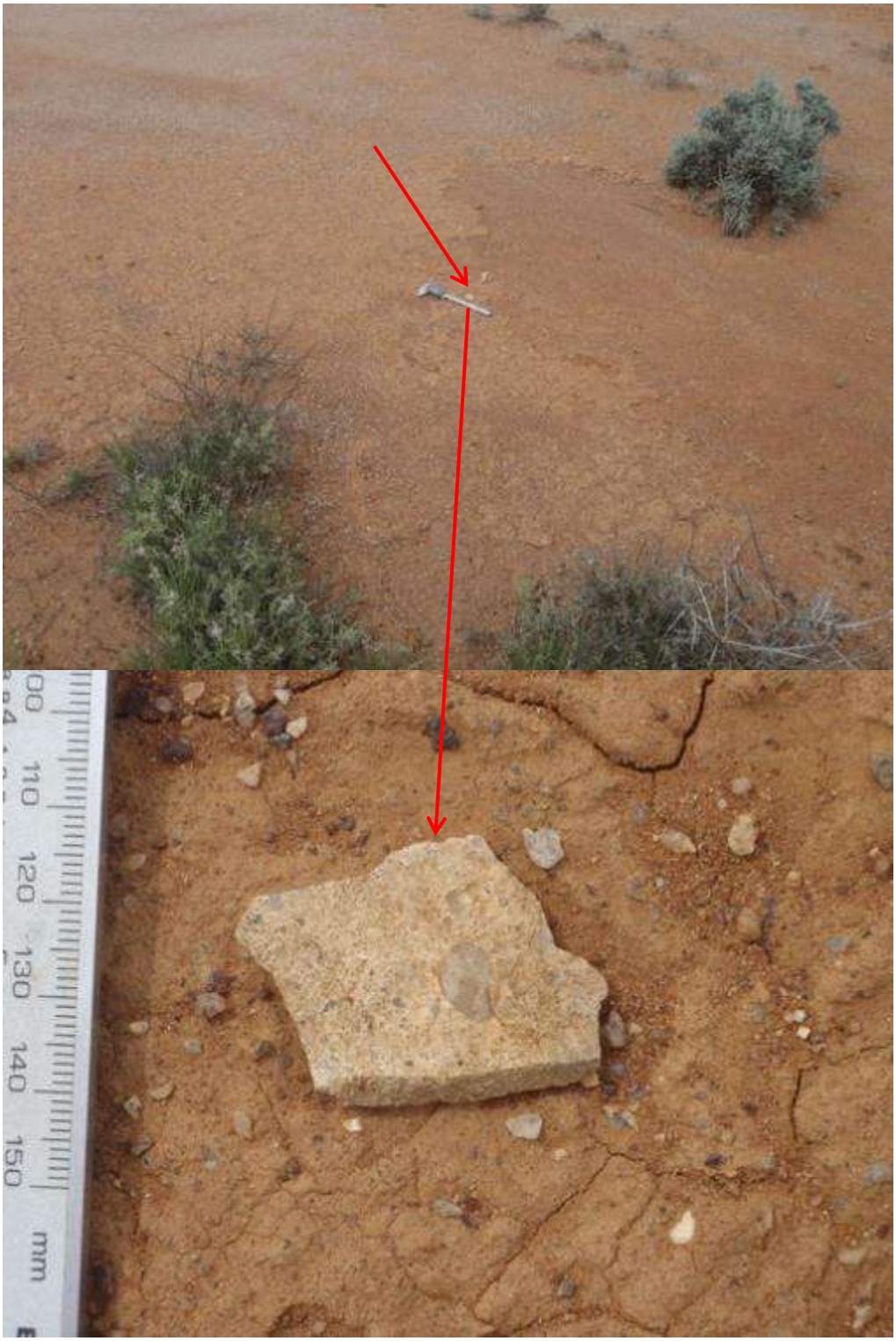


Plate 25: The eroding claypan/alluvial fan washout area in which the silcrete flake piece recorded as BHS-13 was located (Images M. Cotter).

Plate 26: The silcrete flake recorded as BHS-14 (Images P. Hams).

Plate 27: View south along the proposed ETL route to the existing substation.

Plate 28: View north along the proposed ETL route to the existing ETL easement. Image demonstrates degree of ground surface visibility and background noise of quartz material.

Plate 29: View northeast towards location where proposed ETL route joins with existing easement.

Appendix 1: Aboriginal community correspondence log & sample advertisement and letters

COMMUNITY CONSULTATION				
Date	**Organisation /**	**Contact Name**	**Comment**	**OzArk staff/ method**
17.11.10	Barrier Daily Truth	e: 'advertising@bdtruth.com.au' Kristy Tucker	Advert placed to appear in Barrier Daily Truth Saturday 20th November. EOI closure date **Monday 6th December**	
17.11.10	DECCW	Paul Houston DECCW Po Box 2111 Dubbo 2830	Sent Stage 1 Letter advising of project and requesting information of any known Indigenous organisations/individuals who may have an interest in the project. Response due 3rd December 2010	
17.11.10	NTSCORP	Mr P Schultz/Mr G Tonna Po Box 2105 Strawberry Hills 2012	Sent Stage 1 Letter advising of project and requesting information of any known Indigenous organisations/individuals who may have an interest in the project. Response due 3rd December 2010	
17.11.10	ORALRA	Courtney Field ORALRA 11-13 Mansfield St Glebe 2037	Sent Stage 1 Letter advising of project and requesting information of any known Indigenous organisations/individuals who may have an interest in the project. Response due 3rd December 2010	
17.11.10	NNTT	Kashana Cohen-McMeekin e: 'Kashana.Cohen-McMeekin@nntt.gov.au'	Sent Stage 1 Letter advising of project and requesting information of any known Indigenous organisations/individuals who may have an interest in the project. Response due 3rd December 2010	
17.11.10	Lower Murray Darling CMA	Lesley Palmer PO Box 363 Buronga 2739	Sent Stage 1 Letter advising of project and requesting information of any known Indigenous organisations/individuals who may have an interest in the project. Response due 3rd December 2010	
17.11.10	Broken Hill City Council	Mr F Zaknich Po Box 448 Broken Hill 2880	Sent Stage 1 Letter advising of project and requesting information of any known Indigenous organisations/individuals who may have an interest in the project. Response due 3rd December 2010	
17.11.10	Broken Hill LALC	Members: BHLALC C/- J O'Donnell PO Box 392 (84 Oxide St) Broken Hill 2880	sent Stage 1 Letter advising of project - invite EOI by 3rd December 2010	
17.11.10	Barkandji Traditional Owners #6	c/- Principal Legal Officer NTSCORP Po Box 2105 Strawberry Hills 2012	sent Stage 1 Letter advising of project - invite EOI by 3rd December 2010	

16.11.10	Broken Hill LALC	Christine PH: 08 8087 7310 e: 'christine_bhlalc@iinet.net.au	Spoke to Christine who is filling in for Joanne, asked about availability of a site officer next week and fees, advised to email through information and Christine will contact the OzArk office.
16.11.10	NNTT	Kashana Cohen-McMeekin e: 'Kashana.Cohen-McMeekin@nntt.gov.au'	received response indicating registered claim in Broken Hill LGA is Pooncarie Barkandji People #8 c/- NTSCORP Limited
17.11.10	Broken Hill LALC	Christine PH: 08 8087 7310	phoned, no answer, phone rang out 10.08 am
17.11.10	Broken Hill LALC	Christine PH: 08 8087 7310	phoned, no answer, however was able to leave message on answer machine for Christine to contact the office re: site officer availability and fee structure for engagement
18.11.10	Broken Hill LALC	e: 'christine_bhlalc@iinet.net.au	Hi Cheryl, I have organized Dulcie O'Donnell for the sites work for next week. Jo is away until Monday so she we will send through the current Workers Compensation 'Certificate of Currency' and the fee structure when she gets back on Monday. EMAIL received from Christine Tester
23.11.10	Broken Hill LALC	Joanne O'Donnell e: wwalalc@iinet.net.au	Received relevant paperwork.
			FIELDWORK - OzArk Maria Cotter/Pauline Hams BHLALC - Dulcie O'Donnell
25.11.10	Broken Hill LALC	Joanne O'Donnell e: wwalalc@iinet.net.au	Email from Joanne requesting 'approval for our trainee sites officer to receive payment for her time'. Advised by Jodie Benton that we had already submitted a variation and could not add more, suggested money be split btw the two site officers,
01.12.10	DECCW	Paul Houston DECCW Po Box 2111 Dubbo 2830	Received response listing the following groups / individuals who may have an interest in the project area: *Barkindji Elders Council *Badger Bates *Mark Sutton William Bates *Mutawintji Board of Mgmt *Menindee Aboriginal Elders council *Wilyakali Aboriginal Corp.
03.12.10	Barkindji Elders Council	c/- Patsy Quail Box 254 Menindee 2879 (note not as DECCW advised, have updated information)	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**

03.12.10	Badger Bates	107 Gaffney Lane Broken Hill 2880	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**	
03.12.10	Mark Sutton	81 Morgan Street Broken Hill 2880	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**	
03.12.10	William Bates	PO Box 36 Wilcannia 2836	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**	
03.12.10	Mutawintji Board of Mgmt	att: Kim O'Donnell c/- Brett Norman NPWS Broken Hill PO Box 788 Broken Hill2880	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**	
03.12.10	Menindee Aboriginal Elders Council	c/- Steve Millington NPWS Far West Region PO Box 788 Broken Hill 2880	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**	
03.12.10	Wilyakali Aboriginal Corp	Chairperson 84 Oxide Street Broken Hill 2880	posted Stage 1 R2 correspondence to advise of the project EOI close **Tuesday 21st December**	
03.12.10	ORALRA	Courtney Field ORALRA 11-13 Mansfield St Glebe 2037	Received letter in mail indicating we should be in contact with the Broken Hill LALC.	
10.12.10	Mutawintji National Park Board of Management	Pat Laughton PO Box 778 Broken Hill 2880	Received correspondence on behalf of Mutawintji NPBOM indication they would like to be involved in the consultation for this project.	
10.12.10	Mutawintji LALC	Pat Laughton PO Box 778 Broken Hill 2880	Received correspondence on behalf of Mutawintji LALC indication they would like to be involved in the consultation for this project.	
21st December 2010 - project placed on hold - correspondence sent to registered stakeholder to advise them.				
03.03.10	Broken Hill LALC	Joanne O'Donnell e: wwalalc@iinet.net.au PH: 08 8087 7310	Emailed and spoke with Joanne who will follow this up first thing Monday, will be away for the rest of today and tomorrow.	
09.03.10	Broken Hill LALC	Christine e: wwalalc@iinet.net.au PH: 08 8087 7310	Contacted office, Joanne not in however Christine indicated that they would likely have a site officer available for the dates and she would leave a message for Joanne. In addition emailed reminder to Joanne.	
10.03.10	Broken Hill LALC	Joanne O'Donnell e: wwalalc@iinet.net.au PH: 08 8087 7310	Spoke to Joanne, received insurances, Joanne advised they will need to send a Snr and a Jnr and that she will forward a p/o which OzArk will forward to client for approval.	
15.03.10	Broken Hill LALC	Joanne O'Donnell e: wwalalc@iinet.net.au	Stage 2/3 letter & project detail emailed advising FW date for TL route and inviting comment on proposed methodology. **EOI DATE 13 April 2011. FW 24th March 2011**	CB - email

15.03.10	Mutawintji LALC	Pat Laughton e: 'Patrick.Laughton@environment.nsw.gov.au'	Stage 2/3 letter & project detail emailed advising FW date for TL within next two weeks and inviting comment on proposed methodology. **EOI DATE 13 April 2011**	CB - email
Date	**Organisation /**	**Contact Name**	**Comment**	**OzArk staff/ method**
15.03.10	Mutawintji National Park Board of Management	Pat Laughton e: 'Patrick.Laughton@environment.nsw.gov.au'	Stage 2/3 letter & project detail emailed advising FW date for TL within next two weeks and inviting comment on proposed methodology. **EOI DATE 13 April 2011**	CB - email
15.03.10	Mutawintji National Park Board of Management	Pat Laughton e: 'Patrick.Laughton@environment.nsw.gov.au'	Hi Cheryl, Thank you for the update on the project, I will inform the Mutawintji BOM and the Mutawintji LALC and give them a hard copy of your letter 15th March and the project description. Thank you, Pat.	CB – email
FW PARTICIPATION				
24.03.11	Broken Hill LALC	Dulcie O'Donnell Raelene O'Donnell	Participated in FW with Dr Jodie Benton.	
Report Distribution				
26.07.12	Broken Hill LALC	c/- Joanne O'Donnell / CEO PO Box 392 (84 Oxide Street) Broken Hill NSW 2880	Sent copy of draft report for comment, advised the Project Area has been reduced, re-survey not required. Comments due by Monday 27th August 2012.	CB Hard copy
26.07.12	Mutawintji Board of Mgmtn	c/- Mr P Laughton Joint Management Coordinator PO Box 778 Broken Hill NSW 2880	Sent copy of draft report for comment, advised the Project Area has been reduced, re-survey not required. Comments due by Monday 27th August 2012.	CB Hard copy
26.07.12	Mutawintji LALC	Members c/- Mr P Laughton Joint Management Coordinator PO Box 778 Broken Hill NSW 2880	Sent copy of draft report for comment, advised the Project Area has been reduced, re-survey not required. Comments due by Monday 27th August 2012.	CB Hard copy
14.08.12	Mutawintji LALC	Pat Laughton Patrick.Laughton@environment.nsw.gov.au	Hi Cheryl, The MLALC are aware of the review of the Solar Power Project and have no feedback on the draft report. Thankyou. Cheers Pat.	CB email
15.08.12	Broken Hill LALC	Joanne e: wwalalc@iinet.net.au PH: 08 8087 7310	Left message on answer phone and emailed reminder that should BHLALC wish to comment on the report submissions due by Monday next week. phoned @ 9.30 am / 2.00 pm.	CB phone

Expressions of Interest
Cultural Heritage Management

OzArk Environmental & Heritage Management P/L seeks registration of Aboriginal groups or individuals who are interested in being consulted about the cultural heritage assessment for a proposed Solar Power Plant, Broken HIll, NSW. This cultural heritage assessment will assist AGL Energy Ltd to identify and manage any cultural heritage present which has the potential to be impacted by the development. Results will be used to support an application under Part 3A of the EP&A Act for construction and operation of the facility.

The Study Area is located approximately 5 km west of Broken Hill, NSW and the combined development area is approximately 180 ha. The solar facility would connect into the national electricity grid at the TransGrid Broken Hill substation via a 2.7km long 22kV overhead transmission line.

If you hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects or places in the proposed Study Area, please register your interest by fax: 02 6882 0630, post: OzArk EHM PO Box 2069 Dubbo NSW 2830, or by phoning OzArk between 9.00am and 5.00pm week days on 02 6882 0118.

All submissions should be received no later than 5pm on Monday 6th December, 2010.

BD163493

20 — Barrier Daily Truth, Saturday, November 20, 2010

Sample Stage 1 letter

Environment & Heritage Management P/L
ABN: 59 104 582 354

16th November 2010

Members – Broken Hill LALC
c/- Joanne O'Donnell / CEO
PO Box 392
Broken Hill NSW 2880
E: 'wwalalc@iinet.net.au'

Dear Joanne

Re: Aboriginal Heritage Assessment for the proposed Solar Power Project, Broken Hill, NSW.

As you may be aware, the Proponents of development projects, or consulting archaeologists acting on their behalf, are required to provide written notification to the Local Aboriginal Land Council and other Government and non-Government organisations that may have an interest within a given project study area for the purpose of establishing a Registered Stakeholder group for consultation over potential Aboriginal heritage issues.

Hence, OzArk Environmental & Heritage Management P/L is currently seeking Expressions of Interest from relevant Aboriginal Groups and individuals in the Broken Hill area, to form a consultation group to assist in the cultural heritage evaluation for the construction and operation an 50 MW solar photovoltaic (PV) power plant and associated transmission infrastructure in Central West NSW. The Study Area (see attached **Figure 1**) has the potential to be impacted by the development and the cultural heritage assessment will assist AGL Energy Ltd (The Proponent) to identify and manage any cultural heritage present. Results will be used in the environmental assessment of an application under Part 3A of the EP&A Act for development of the facility.

The proposed Solar PV Power Plant would be located approximately 5 km south west of Broken Hill. Approximately 180 ha of land would be required for the Solar PV Plant. Along with the PV plant, the proposed development would also include the installation and operation of a double circuit 22 kV overhead line (OHL), approximately 2.7 km long, to connect the plant to the TransGrid Broken Hill substation. If you hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects or places in the proposed Study Area please register your interest by contacting our office. The closing date for expressions of interest for this project will be **Friday December 3rd 2010.**

If your organisation wishes to register interest it is noteworthy that as per the DECCW guidelines we are required to provide your details to the DECCW unless advised you do not wish your details to be released.

Further, if Broken Hill LALC can recommend any other Indigenous groups with a cultural heritage interest in this area we would appreciate their details so that we may liaise with them. Once relevant groups and individuals have been identified, they will form part of the formal consultation and evaluation process for the project.

Yours truly

Cheryl Burke
Office Manager

Stage 1 responses

NSW GOVERNMENT
Lower Murray Darling CMA CATCHMENT MANAGEMENT AUTHORITY
32 Enterprise Way,
PO Box 363
Buronga, NSW, 2739
☎ 03 5021 9460
Fax 03 5021 1308

Our Ref (A479041)

1 December 2010

OzArk Environmental & Heritage Management P/L
145 Wingwarra St
P.O Box 2069
Dubbo
NSW 2830

Dear Cheryl

Re: *Aboriginal Heritage Assessment for the proposed Solar Power Project, Broken Hill, NSW*

Thank you for your letter dated 16th November requesting assistance in identifying Aboriginal stakeholder groups or persons who may have an interest in your project area.

The Lower Murray Darling Catchment Management Authority (LMD CMA) acknowledges that CMAs have been listed in *Section 4.1.2 (g)* of the *Aboriginal Cultural Heritage Consultation Requirements for proponents 2010*, under *Part 6, National Parks and Wildlife Act 1974* as a source of information to obtain the "names of Aboriginal people who may hold cultural knowledge relevant to determining the significance of Aboriginal *objects* and/or *places*".

It is recommended by the LMD CMA that you contact the following Aboriginal Community groups in regard to cultural heritage matters within the project area.

- Broken Hill Local Aboriginal Land Council on 08 8087 7413

Please note the LMD CMA takes no responsibility for the groups listed as being the only persons or groups who may have a cultural heritage interest in your project area and further investigation may be necessary within your consultation process, the Dept. of Environment Climate Change and Water would be a good point of contact.

Sincerely,

Lesley Palmer
General Manager

Lower Murray Darling CMA
Respect for our communities & the environment

NSW GOVERNMENT | Environment, Climate Change & Water

Your reference : Broken Hill Solar Farm
Our reference : DOC10/52339
Contact : Paul Houston 68835361

Ozark
PO Box 2069
DUBBO NSW 2830
Att: Cheryl Burke

26th November 2010

Dear Cheryl,

WRITTEN NOTIFICATION AS REQUIRED UNDER DECCW ABORIGINAL CULTURAL HERITAGE REQUIREMENT FOR PROPONENTS 2010 – for a proposed Solar Farm, Broken Hill NSW

I refer to your letter dated 16th November 2010 to the Department of Environment Climate Change and Water (DECCW) regarding the above matter.

A list of known Aboriginal parties that DECCW feels is likely to have an interest in this development is attached as Attachment 1 (overleaf). Please note this list is not necessarily an exhaustive list of all interested Aboriginal parties and receipt of this list does not remove the requirement of a proponent/consultant to advertise in local print media and contact other bodies seeking interested Aboriginal parties, in accordance with the Interim Requirements.

If you wish to discuss any of the above matters further please contact me, at your earliest convenience, on (02) 6883 5361.

Yours sincerely

Paul Houston
Aboriginal Heritage Planning Officer
EPRG North- West Branch

The Department of Environment and Climate Change is now known as
The Department of Environment Climate Change and Water.

PO Box 2111, Dubbo NSW 2830
48-52 Wingewarra St Dubbo NSW
Tel: (02) 6883 5330 Fax: (02) 6884 9382
www.environment.nsw.gov.au

ATTACHMENT 1

DECC LIST OF ABORIGINAL STAKEHOLDER GROUPS WITHIN THE BROKEN HILL - AREA THAT MAY HAVE AN INTEREST IN THE PROJECT; PROVIDED AS PER THE 'INTERIM COMMUNITY CONSULTATION REQUIREMENTS FOR APPLICANTS'.

Name/Title	Organisation/Affiliation	Address
Arthur Kirby	Barkindji Elders Council	C/- PO Box 87 Euston NSW 2737
Badger Bates		107 Gaffney Lane Broken Hill NSW 2880
Mark Sutton		81 Morgan St Broken Hill NSW 2880
William Bates		Po Box 36 Wilcannia NSW 2836
Chair, Mutawintji Board of Management	Ms Kim O'Donnell	C/- Brett Norman, Area Manager NPWS Broken Hill Area Office PO Box 788 Broken Hill NSW 2880
Menindee Aboriginal Elders Council		C/- Steve Millington, Regional Manager NPWS Far West Region PO Box 788 Broken Hill 2880
Wilyakali Aboriginal Corporation		84 Oxide St BROKEN HILL NSW 2880

The Department of Environment and Climate Change is now known as
The Department of Environment Climate Change and Water

PO Box 2111, Dubbo NSW 2830
48-52 Wingewarra St Dubbo NSW
Tel: (02) 6883 5330 Fax: (02) 6884 9382
www.environment.nsw.gov.au

Mutawintji National Park Board of Management
c/- PO Box 778
Broken Hill NSW 2880
Tel: (08) 80803207 Fax: (08) 80803201

Date: 9th December 2010

Re: Aboriginal Heritage Assessment for the Proposed Solar Power Project, Broken Hill, NSW.

Dear Cheryl,

The Mutawintji Board of Management and the Mutawintji Local Aboriginal Land Council (MLALC), have Expressions of interest to be involved in the Registered Stakeholder group for consultation to assist in the cultural heritage evaluation for the construction and operation of the proposed Solar Power Project concerning potential Aboriginal heritage issues.

The Mutawintji Board of Management and the MLALC are contactable through the Joint Management Coordinator.

Yours truly,

Pat Laughton
Mutawintji Area
Joint Management Coordinator
Parks & Wildlife Group - Far West Region
Department of Enviroment Climate Change & Water
183 Argent Street - Po Box 778
Broken Hill NSW 2880
Ph: (08) 80803207 Fax: (08) 80803201
Mobil: 0428277353

National Native Title Tribunal

New South Wales and Australian Capital Territory Registry
Level 25, 25 Bligh Street
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2000
Telephone (02) 9235 6300
Facsimile (02) 9233 5613

17 November 2010

Cheryl Burke
Office Manager
Oz Ark Environment & Heritage Management P/L
PO Box 2069
DUBBO NSW 2830

Our Reference: 3919/10kc

Dear Cheryl

Native Title Search Results of Broken Hill Local Government Area

Thank you for your letter of 16 November 2010.

My search on 17 November 2010 found:

Register Type	NNTT Reference Numbers
National Native Title Register	Nil.
Register of Native Title Claims	NC97/32
Unregistered Claimant applications	Nil.
Register of Indigenous Land Use Agreements	Nil.

I have included an extract from the Register of Native Title Claims, mapping of the application area and a NNTT Registers fact sheet to help you understand the search result.

Please note that there may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed in the Federal Court may not appear on the Tribunal's databases.

Resolution of native title issues over land and waters.

Freecall 1800 640 501
www.nntt.gov.au

Stage 2/3 Letters

Environmental & Heritage Management P/L

15th March 2011

Members – Broken Hill LALC
c/- Joanne O'Donnell / CEO
PO Box 392
Broken Hill NSW 2880
E: 'wwalalc@iinet.net.au'

Dear Joanne

Re: Aboriginal Heritage Assessment for the proposed Solar Power Project, Broken Hill, NSW.

Thank you for the Broken Hill LALC registration of interest to form part of the stakeholder group to be consulted concerning potential Indigenous heritage issues for the proposed Solar Power Project. We would like to advise the Broken Hill LALC that after temporary suspension in December 2010, this project has now recommenced. Information outlining the details of the proposed project can be found in **Attachment 1.**

Initial project constraints created the need for a field assessment to be undertaken prior to all stakeholders formally expressing interest. Due to these tight timeframes a survey of the proposed Project Site was carried out in November 2010 by OzArk, in the company of Site Officers from Broken Hill Aboriginal Land Council (BHLALC). The area defined as the Project Site is large and full survey was not feasible although survey transects targeted the landforms of most archaeological potential. Now that the Transmission Line (TL) route has been determined, see attached **Figure 1**, it must now be assessed.

The following information states the proposed methodology for the cultural and archaeological assessment of the Transmission Line (TL) route. As part of the consultation process we request that BHLALC review this information and provide feedback. These comments can either be verbal or in writing, but should be received no later than 28 days after receipt of this letter, **13th April 2011**. If your organisation can share any Aboriginal cultural heritage knowledge relevant to the proposed study area, we welcome this input so as to improve our assessment outcomes.

The TL route survey has been scheduled within the next two weeks, thus we would appreciate your prompt response should you wish to incorporate your comments within the methodology outlined below.

Methodology for the current investigation:

- Provide registered stakeholders with maps of the proposed impact location and seek further comment of any known Indigenous cultural values. A map can be found accompanying this letter in **Attachment 1.**

- In relation to the above, a 10 x 10 km search centred on the entire Project Site was submitted to the DECCW. The results identified seventeen (17) Aboriginal sites registered on the DECCW AHIMS database, none within the current Study Area. An additional fourteen (14) sites were recorded during the survey in November 2010. These will be plotted to identify the sites near the impact footprint so we can determine if they will be affected by the development.

- Provide the stakeholders with the opportunity to identify if there is a need to meet and consult elders to receive additional information about the current Study Area / Project Site. If so this should be flagged with OzArk so that we may manage any additional meetings on a case by case basis.

- To undertake additional physical survey of the Transmission Line (TL) route within the Project Site. With respect to this the Proponent has elected to make one (1) position per day, available for representatives from the registered stakeholder groups, of which there are three, to accompany the OzArk archaeologist during the fieldwork. This will ensure Indigenous involvement with the physical archaeological assessment of the study area.

- Each stakeholder group is responsible for their Occupational Health and Safety (OH&S). It is not OzArk's responsibility to determine 'fitness for work' of your nominated site officer. Your organisation must accept full responsibility for your own risk management. If the senior OzArk representative chooses not to accept the risk associated with an individual's fitness for the specific work at hand, then OzArk expresses the right to exclude any site officer from participating in an OzArk managed project.

- Discuss in the field, at the end of the field survey, any findings, identified cultural values, management of cultural heritage and culturally acceptable mitigation measures to be considered.

- After survey, participating groups are asked to prepare a letter which clearly documents their understanding of the project, detail any associated cultural values of the study area and to provide any comment on proposed management and/or mitigation measures to be employed within the study area.

- OzArk will prepare a draft report based on the field survey that will include letters from the stakeholder groups and their assessment of cultural significance for the area or recorded sites. Each group will be invited to review this draft report and provide comment within a given time frame and feedback will be included in report finalisation and provided as an appendix to the final report.

- A copy of the final report, or advice of its availability, will be provided to each stakeholder group prior to the Proponent submitting it to the relevant authorities.

- **The field assessment:** The survey team will comprise of an OzArk archaeologist and one (1) Indigenous Site Officer. OzArk would like to invite *one* member from Broken Hill LALC to participate in the field assessment, scheduled **Thursday 24th March 2011**. Representatives are to meet at **8.30 am** at the Broken Hill LALC office in Oxide Street. During the field assessment the proposed route options, as shown on **Figure 1** will be assessed.

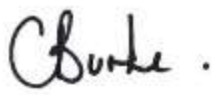
Requirements prior to field assessment: A group wishing to send a representative for the field assessment ***must have current workers compensation insurance***[5] and are required to provide a certificate of currency to our office no later than <u>three days</u> prior to the assessment. Unfortunately we <u>will not</u> be able to allow participation in the field assessment without this certificate (due to NSW OH&S legislation).

Fee offer: As per the survey in November 2010, the Broken Hill LALC should submit their structure of fees *prior to fieldwork* for submission to the Proponent so that the fee offer can be determined. Invoices after the survey are to be addressed to Sinclair Knight Merz, PO Box 164, NSW, 2065 and Attention: Damian Williams.

[5] Note that OzArk has a copy of the BHLALC certificate of currency expiry date 30th June 2011.

If you have comments or feedback which you wish to incorporate in this methodology prior to fieldwork, please reply either verbal or in writing, by close of business **13th April 2011.** As noted fieldwork is scheduled a week prior to this date, thus we would ask for your prompt response if you have any comments relating to this methodology.
If you have any queries, please feel free to contact our office.

Kind regards



Cheryl Burke
Project Officer

Solar Power Project, Broken Hill – ATTACHMENT 1

Project Description

The Broken Hill Solar Photovoltaic (PV) Project involves the construction and operation of a 50 megawatt (MW) solar PV plant at Broken Hill, in Far Western NSW.

The Solar Flagships program is part of the Australian Government's $4.5 billion Clean Energy Initiative, announced in the May 2009 Budget. The Government has committed $1.5 billion to support the construction and demonstration of up to four large-scale solar power plants in Australia, using solar thermal and photovoltaic (PV) technologies. The Government's aim is to establish up to 1000 megawatts (MW) of large-scale solar power generation capacity. Round 1 for the Solar Flagships program will select one solar thermal project and one PV project, with a target of up to 400 MW of combined generation capacity AGL's Stage 1 submission proposed PV plants ranging from 30 to 50 MW in ACT, NSW, SA, VIC and QLD. The Broken Hill Solar PV Project has been selected as one of AGL Energy's solar projects in NSW.

As such, AGL Energy is seeking Project Approval for the development of the Broken Hill Solar PV Project. The total capacity of the Nyngan Solar PV project would be 50 MW. The project site is located in far western NSW, approximately 6 km south-west of the city of Broken Hill. The location of the project and its immediate surrounds is shown on **Figure 1-1**.

The PV plant site is located within the unincorporated area which is administered by the NSW Department of Lands, Western Division, and comprises rural land. The PV plant site is located between the Barrier Highway to the north and the Peterborough Broken Hill railway line to the south, wholly within Crown land (managed by the Land and Property Management Authority).

Approximately 170 hectares of land would be required for the 50 megawatt (MW) PV plant at Broken Hill. The site comprises a cleared, relatively flat area with numerous unsealed access tracks scattered throughout. There is currently one residence located in the northern part of the property with several other sheds scattered nearby.

Along with the PV plant, the proposed development would also include the installation and operation of a double circuit 22kV overhead transmission line, approximately 2.7 km long, to connect the PV plant to the TransGrid Broken Hill substation. The proposed easement of transmission line would be 30 metres. The 22kV transmission line is located within the Broken Hill LGA and would traverse three land holdings, and also the Peterborough Broken Hill railway line.

Solar Power Project, Broken Hill – ATTACHMENT 1

Figure 1-1 | Project area and surrounds

Temporary Suspension letters sample

Environmental & Heritage Management P/L

ABN 59 104 582 354

21st December 2010

Members – Broken Hill LALC
c/- Joanne O'Donnell / CEO
PO Box 392
Broken Hill NSW 2880
E: 'wwalalc@iinet.net.au'

Dear Joanne

Re: Aboriginal Heritage Assessment for the proposed Solar Power Project, Broken Hill, NSW.

The Broken Hill LALC has recently expressed interest in the AGL Solar Power Project, and undertaken field work as part of the proposed development. As your organisation is a registered Aboriginal party, we would like to inform you that AGL Energy Ltd has advised that the project has been temporarily suspended.

Should the project re-commence in 2011, Broken Hill LALC will be advised and continue to be involved in the cultural heritage assessment process.

If you have any queries, please feel free to contact our office.

Kind regards

Cheryl Burke
Office Administrator

OzArk Environmental & Heritage Management P/L
145 Wingewarra St / PO Box 2069 DUBBO NSW 2830
WEB: www.ozarkehm.com.au
ABN: 59 104 582 354

26th July 2012

Members – Broken Hill LALC
c/- Joanne O'Donnell / CEO
PO Box 392 (84 Oxide Street)
Broken Hill NSW 2880

Dear Joanne

Re: Proposed Solar Power Project, Broken Hill, NSW.

As you may recall the Broken Hill LALC expressed interest in the AGL Solar Power Project in 2010. As part of the proposed development, field work was undertaken by BHLALC site officers Ms Dulcie O'Donnell and Ms Raelene O'Donnell. In December 2010 all registered stakeholders received notification that the project had been temporarily suspended, we would now like to advise that the project has recommenced.

Due to the restart of the project, we invite the BHLALC to review the enclosed draft report and submit feedback. It is noteworthy that as the Project Area has been reduced, re-survey is not required. To ensure any comments you wish to make are incorporated into the final report, we ask that you review the enclosed document and suggested management recommendations, and provide us with your comments within the required twenty eight (28) period. Any relevant comments you have will then be incorporated into the final report.

We ask that you submit your reply by close of business **Monday 27th August, 2012**. Should you have any queries or require clarification of the content contained in the enclosed document, please contact our office within this timeframe and we will be able to assist.

If you have any queries, please feel free to contact our office.

Kind regards

CBurke

Cheryl Burke
Consultation Officer

Tel: 6882 0118; Fax: 6882 0630; Mob: 0403 763 504 / 0423 198 898
E-mail: jodie@ozarkehm.com.au / phil@ozarkehm.com.au / cheryl@ozarkehm.com.au

Appendix 2: Aboriginal Site Type Definitions

Open camp sites

Often called stone artefact scatters, these sites (for the purposes of the DEC AHIMS database) were in the past defined by the presence of two or more stone artefacts located within 50 m of one another. Current guidelines, however, delineate no hard and fast determinations on requisite artefact numbers, more loosely describing these campsites as places exhibiting evidence of past human activity. This can be, and is most frequently, in the form of stone artefacts, but may also include other evidence such as hearths or midden material. Such sites provide evidence for the range of activities that may have been undertaken at a particular place, including the production of stone tools and the preparation of food including the butchering of animals or grinding of seeds. However, the distinction between a single, isolated artefact versus a place where numerous artefacts have been recorded together provides a necessary division in terms of the possible information that a site can reveal about past activities. Further information recorded about open sites includes assessments of the sites' integrity (how intact the site is) and subsequently whether sub-surface deposits are thought to be present.

Isolated Finds

An artefact, usually of stone, but possibly of other materials, that is located but has no relationship to other identifiable archaeological features.

Natural Mythological or Cultural / Ceremonial sites

Natural mythological sites can be any natural feature and like a cultural / spiritual are not detectable without the traditional knowledge of specific areas. .

Ground Ovens

Evidence of ground ovens is today often only in the form of a collection of stones that may show evidence of burning or contain charcoal between them. These would in the past have been stones at the bottom of a small pit, that was dug and lined with stones such that a fire could be built inside and a piece of meat could be put in and the hole covered over for cooking in oven like conditions. Sometimes certain stones themselves were heated in this way as a pre-treatment for raw materials thought to be improved by the heating process.

Quarries

Locations of outcropping stone (or in some cases ochre) that have been utilised for the extraction of raw materials for the manufacture of stone tools or paints. These sources will sometimes provide evidence of the removal of stone for the purpose of knapping, although this evidence can sometime be challenging to identify.

Appendix G Hydrology Assessment

Broken Hill Solar Plant

HYDROLOGY ASSESSMENT

- Final

Broken Hill Solar Plant

HYDROLOGY ASSESSMENT

- Final

Sinclair Knight Merz
ABN 37 001 024 095
100 Christie Street
St Leonards NSW 2065 Australia
Postal Address
PO Box 164 St Leonards NSW 2065 Australia
Tel: +61 2 9928 2100
Fax: +61 2 9928 2500
Web: www.skmconsulting.com

Contents

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
0	2/12/2010	J Wall D Hughes	Peter Faggion	1/12/2010	Original issue
1	18/09/12	J Lazorov	Peter Faggion	20/09/2012	Editorial review

Distribution of copies

Revision	Copy no	Quantity	Issued to
0	1	1	AGL – D. Landfear
1	1	1	AGL – D. Landfear

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File name:	I:\HARB\Projects\HA01345\Deliverables\Reports\Environmental\NSW\Broken Hill\EA\Specialist Studies\Hydrology\BrokenHill Hydrology Report_Rev0.doc
Author:	A Milner, A Boronkay, D Hughes, J Wall
Project manager:	Peter Faggion
Name of organisation:	AGL Energy
Name of project:	Solar Flagships Program
Name of document:	Hydrology assessment
Document version:	Final
Project number:	HA01345

1. Introduction

1.1. Background to the project

The Solar Flagships program is part of the Australian Government's $4.5 billion Clean Energy Initiative, announced in the May 2009 Budget. The Government has committed $1.5 billion to support the construction and demonstration of up to four large-scale solar power plants in Australia, using solar thermal and photovoltaic (PV) technologies. The Government's aim is to establish up to 1000 megawatts (MW) of large-scale solar power generation capacity. Round 1 for the Solar Flagships program will select one solar thermal project and one PV project, with a target of up to 400 MW of combined generation capacity.

AGL Energy Limited (AGL) has been shortlisted as one of four solar PV projects for funding under the Solar Flagships program. AGL is developing up to five solar PV projects with a total capacity of up to 200 MW AC at multiple properties across Australia. This approach offers the Commonwealth the opportunity to ensure that multiple stakeholders in multiple jurisdictions benefit from the Solar Flagships Program, providing jobs and economic growth and industry development across the country. Furthermore, the size of AGL's plants simplifies siting issues, allows easier and cheaper grid connections, and provides resource and time zone diversity.

1.2. Purpose of this document

This hydrology assessment has been prepared to provide an assessment of the hydrologic aspects of the Broken Hill Solar Plant. The aim of the assessment is to identify any mainstream flooding or site drainage characteristics for the project, including the solar photovoltaic (PV) plant and associated infrastructure. Information used as part of the assessment includes:

- Site inspection and stakeholder consultation.
- Review of available data.
- Assessment of mainstream flooding.
- Site drainage.
- Potential stormwater erosion.

A summary of the information contained within each section of this report is provided below.

Chapter 1 – introduces the project, its broad strategic context and provides a brief description of the site location.

Chapter 2 – describes site conditions on the basis of information gathered during site inspections, explains the legislative context based on a meeting with council officers and provides details on the data available for a preliminary hydrology assessment for the site.

Chapter 3 – identifies potential inundation of the site due to mainstream flooding.

Chapter 4 – identifies and discusses inundation due to local catchment drainage on the site.

Chapter 5 – presents stormwater management issues associated with the construction and operation of the project.

Chapter 6 – provides conclusions and recommendations.

Chapter 7 –references.

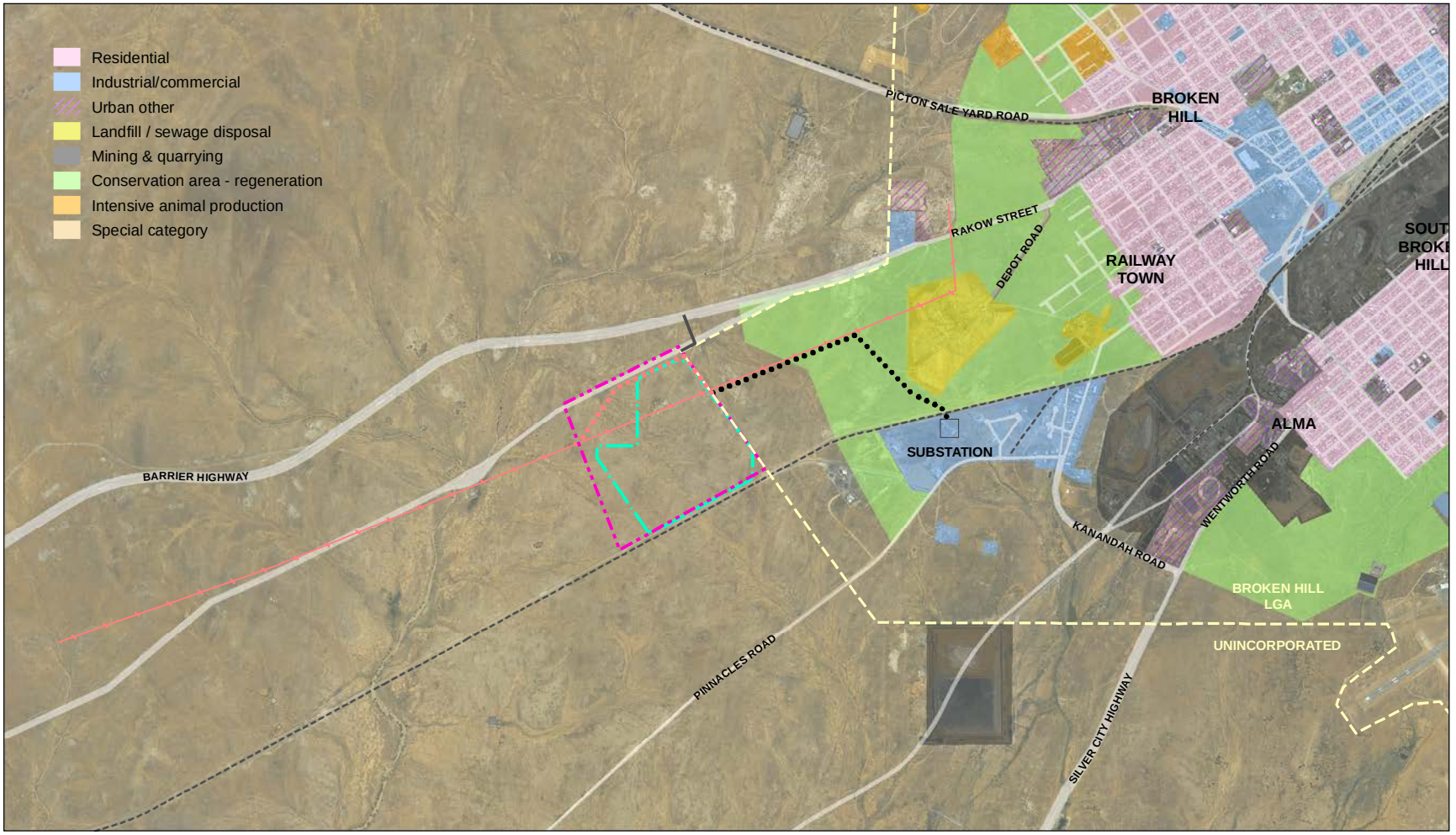
1.3. Site description

The project site is located in far western NSW, approximately 6 km south-west of the city of Broken Hill. The location of the project and its immediate surrounds is shown on **Figure 1-1**.

The solar PV plant site is located within the unincorporated area which is administered by the NSW Department of Lands, Western Division, and comprises rural land. The 200 hectare solar PV plant site is located between the Barrier Highway to the north and the Peterborough Broken Hill railway line to the south, wholly within Lot 6806 Plan 823918 (Crown land managed by the Land and Property Management Authority).

Of the 200 hectare site, approximately 140 hectares of land would be required for the nominal 50 megawatt (MW) PV plant at Broken Hill. The site comprises a cleared, relatively flat area with numerous unsealed access tracks scattered throughout. There is currently one residence located in the northern part of the property with several other sheds scattered nearby.

Along with the PV plant, the proposed development would also include the installation and operation of a double circuit 22kV overhead transmission line, approximately 2.7 km long, to connect the PV plant to the TransGrid Broken Hill substation. The proposed easement of transmission line would be 30 metres. The 22kV transmission line is located within the Broken Hill LGA and would traverse three land holdings, and also the Peterborough Broken Hill railway line.



- **Figure 1-1 Location map**

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Spatial Team - Prepared by : JC
Checked by : JL

2. Data Collection and Review

2.1. Overview of the site

A site visit was conducted on 27 October 2010, to collect information on hydrological issues for the site. The majority of the Broken Hill PV plant site is covered in chenopod shrubland, which includes saltbush and bluebush.

The main drainage system is located to the north-west of the site. The egress point is located approximately 400 metres east from the north-eastern corner of the site where a farm dam lies within the creek. Overflow from the dam, and other smaller catchments flowing north-west, flow into Stirling Vale Creek. Stirling Vale Creek emanates from land immediately west of Broken Hill. Other smaller drainage catchments discharge from the site along the eastern, southern and western boundaries.

Anecdotal evidence of water movement and flooding on the PV plant site was sought from the landholder, who has occupied the site for approximately four years. Significant storms have occurred, however the site has not experienced significant overland flooding.

The drainage from the southern part of the site (or upper internal catchment of the site), is typically sheet flow into shallow gullies that are generally 0.3 to 0.5 metres deep and 1 to 2 metres wide. The gullies increase in size towards the dam where flow is expected to increase. Erosion caused by this increased flow is evident along some of the lower (northern) drainage channels. Waterlogged land has been observed adjacent to the farm dam by the current landholder and from information by the previous long-term landholder.

Plate 2-1 shows the drainages lines and typical landscape in the south eastern part of the site looking north-west. Shallow gullies and sheet flow are the typical drainage systems. **Plate 2-2** shows typical drainage and landscape in the south western part of site looking north-east. **Plate 2-3** shows the area to the west of the farm house (looking east). **Plate 2-4** shows a typical drainage line in the area west of the farm house.

- **Plate 2-1 Drainage and landscape in the south-eastern part of the site (looking north-east)**

- **Plate 2-2 Drainage and landscape in the south-western part of the site (looking north-west)**

- **Plate 2-3 Landscape west of the farm house (looking east)**

- **Plate 2-4 Typical drainage line in the area west of the farm house**

Plate 2-5 shows the farm dam located at the northern boundary of the site. The dam is approximately 25 m^2 and 1.5 metres deep. There is no formalised spillway from the dam; however,

surcharge from the dam would flow around the dam wall and westward towards Stirling Vale Creek. **Plate 2-6** illustrates typical drainage channels flowing to the farm dam.

- **Plate 2-5 Farm dam**

- **Plate 2-6 Drainage channels into farm dam**

During the site inspection, drainage structures along the Barrier Highway in the vicinity of the site were identified. This assists understanding of the potential flooding from other creeks within the Stirling Vale Creek catchment that may potentially influence inundation of the site. **Table 2-1** summarises the waterway structures and their estimated capacities (based on their observed dimensions) prior to flow either surcharging along the highway formation or over the highway.

- **Table 2-1 Barrier Highway water structures**

Location	Description	Estimated capacity (m^3/s)
Unnamed Creek Immediately east of site	2 x 2.4 m W x 1.5 m H Box culvert	14
Stirling Vale Creek NW of site	4 x 2.4 m W x 3 m H Box culvert	76
Unnamed Creek 400 m west of Stirling Vale Creek	6 x 1.8 m W x 0.6 m H Box culvert	8
Unnamed Creek 1,100 m west of Stirling Vale Creek	4 x 2.4 m W x 3 m H Box culvert	76
Unnamed Creek 1,900 m west of Stirling Vale Creek	6 x 2.4 m W x 3 m H Box culvert	115

2.2. Consultation with council

A meeting was held with Peter Oldsen, Group Manager Sustainability, of Broken Hill City Council on 28 October 2010. The PV plant site is located outside the local government area (LGA).

The largest storm event in local knowledge is the 1992 event (either December 1991 or January 1992). Council considers this event to be the local 1% Annual Exceedance Probability (AEP) (this is equivalent to 100 year ARI) event for planning purposes, and that short, intense storms occur at Broken Hill in summer (P Oldsen 2010, pers comms., 28 Oct 2010).

The Barrier Highway, located near the site, has no record of overtopping or flood damage during the 1992 event. Council considers that the road and associated drainage structures have a 100 year Average Recurrence Interval (ARI) capacity. It is unlikely that Stirling Vale Creek would create backwater inundation into the site (P Oldsen 2010, pers comms., 28 Oct 2010).

2.3. Review of available data

2.3.1. Topographic data

Photogrammetry techniques were used to develop a 0.3 metre contour dataset and a 12 metre x12 metre digital terrain model (DTM) over the site extent. Both the contour data and the digital terrain model covered a 200 metre wide buffer along the site boundary. The contour data shows that the

site slopes from southeast to northwest, dropping from approximately 285 metre AHD to 270 metre AHD over 1.4 km (an average of 1.0%). The contour data shows that the majority of the site drains to the northern boundary either through the existing dam or over the access road. Smaller portions of the site drain to other site boundaries as noted in **Table 2-2**.

- **Table 2-2 Catchment areas that drain towards the site boundaries**

Site boundaries	Internal catchment area that drains to the site boundary (ha)	Proportion of property within the catchment area (%)
North	126	73
East	8	4
South	9	5
West	31	18
Total	**174**	**100**

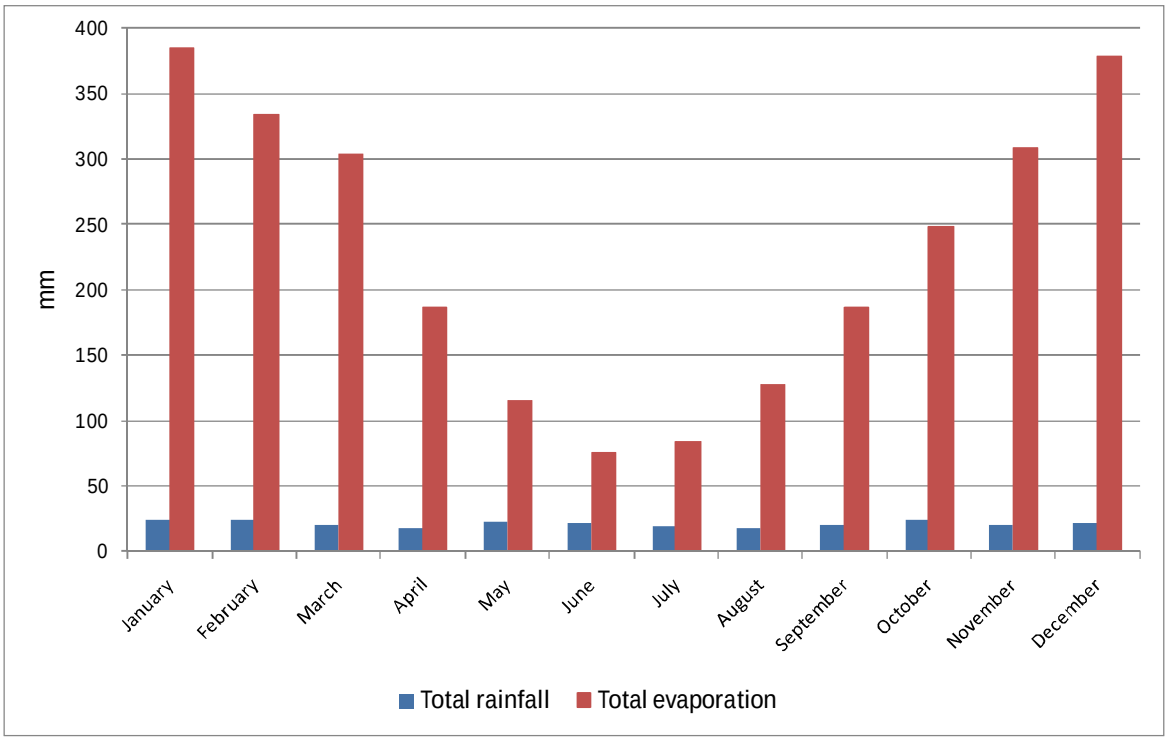
For the areas located outside the site, 20 metre contour data was available from the Land and Property Management Authority (LPMA) and a 90 metre x 90 metre digital terrain data was sourced from the Shuttle Radar Topography Mission (SRTM). A comparison between the 0.3 metre and 20 metre contour data indicates that the 20 metre contour data overestimates elevation within the site by up to 4 metres through the centre of the site. A comparison between the digital terrain data sets, the 12 metre x 12 metre and 90 metre x 90 metre digital terrain data, shows the 90 metre x 90 metre digital terrain overestimates the elevation on average by 2.85 metres throughout the site. However, an assessment of the drainage catchment boundaries was performed and the general catchment boundaries and flow directions were consistent between the datasets.

2.3.2. Climatic data

The project site and surrounding area is subject to very low rainfall. The average annual rainfall recorded at Broken Hill rainfall station (AWS 47007), located 7 km from the site, is 255 mm (records from 1889 to 2010 obtained from the Bureau of Meteorology). The average annual evaporation recorded at Umberumberka Reservoir (AWS 470369), located 25 km from the site, is 2,730 mm (records from 1965 to 2010 obtained from the Bureau of Meteorology). Evaporation exceeds rainfall in all months. Monthly average rainfall and evaporation are presented in **Figure 2-1**.

This region is subject to infrequent, high intensity, short duration events (P Oldsen 2010, pers comms., 28 Oct 2010). While such rainfall is infrequent, **Chapter 4** on site drainage discusses the

importance of future design phases considering the use of a rainfall-runoff model and pluviograph rainfall data (6 minute interval data) to refine flooding estimates for these infrequent events.



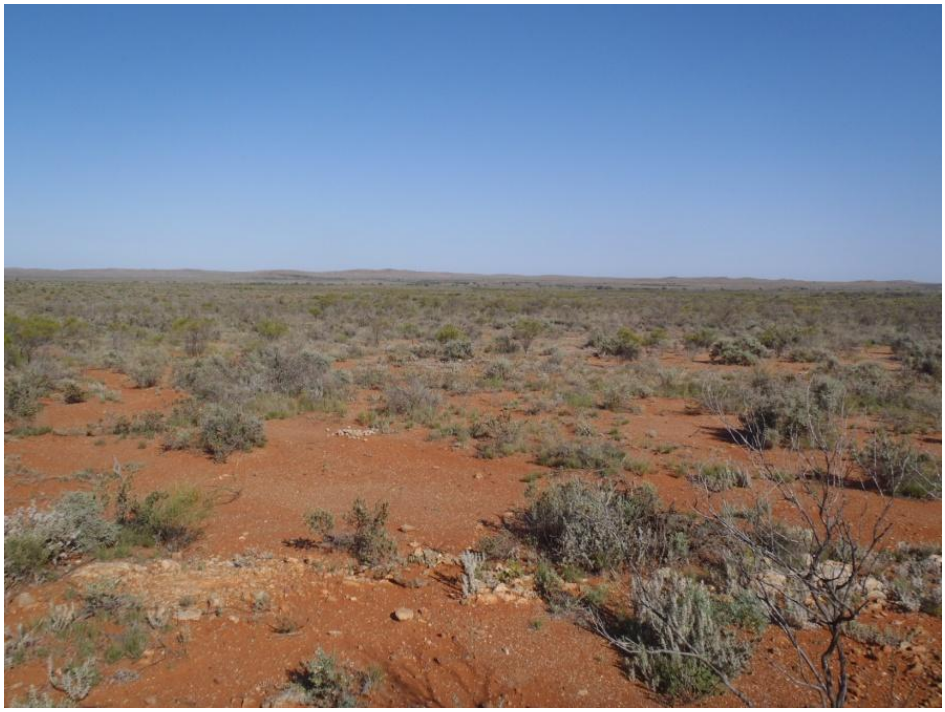
- **Figure 2-1 Average monthly rainfall and evaporation at the site**

2.3.3. Soils

Soils within the study area are thin and weathered. They are likely to have derived from weathered metamorphics, while silty clays are contributed by ephemeral streams within the study area. From interpretation of aerial imagery, there is low potential for gilgai soil to occur within the study area. Gilgai soils have high shrink-swell potential.

Soils found on the site are shown in **Plate 2-7** and **Plate 2-8.** The soils are considered moderately erodible, and increased erosion may occur where soils are not protected by vegetation. Gullying is evident where there is a lack of vegetation.

- **Plate 2-7 Typical soils of the site**



- **Plate 2-8 Typical soils of the site**

3. Mainstream Flooding

3.1. Background

Stirling Vale Creek rises from land immediately west of Broken Hill, flowing first westerly to the Highway then in a southwest direction to the Peterborough-Broken Hill Railway Line. The main arm of the Stirling Vale Creek is located approximately 700 metres to the north-west of the site boundary. Stirling Vale Creek drains a catchment of 34 km^2 at Barrier Highway and 58 km^2 at the Peterborough-Broken Hill Railway Line.

The only other nearby creek is Kelly's Creek which runs east to west approximately 4 km south of the site. Kelly's Creek is a tributary of Stirling Vale Creek. Due to its location, Kelly's Creek was deemed not to be a risk for mainstream flooding at the site.

Stirling Vale Creek has the potential to contribute to flooding of the site either by backwater effects in which elevated water levels in Stirling Vale Creek also create elevated water levels in the tributary on the site, or by flow surcharging the highway at waterway crossings (culverts) and flowing onto the site. The first potential source of flooding was assessed using a hydraulic model of Stirling Vale Creek and the site tributary. The second potential source of flooding is considered to be negligible as council noted that the highway was not overtopped in major storm events. This assumption was assessed by analysing the capacities of the Barrier Highway culverts in relation to estimated peak flows. A discussion of the assessments is in the following sections.

3.2. Estimation of design discharge

In the absence of any streamflow monitoring data for Stirling Vale Creek that could be used to derive design flows by flood frequency analysis, design flows were estimated using the Probabilistic Rational Method in accordance with procedures in *Australian Rainfall & Runoff* (ARR). This method is appropriate for estimating peak discharge in catchments less than 250 km^2.

ARR recommends the Western NSW method for the region of Broken Hill. However, the Western NSW method does not provide peak discharge parameters for a 100 year ARI. It provides values for extrapolation up to the 50 year ARI event. The Western NSW method gives a 50 year ARI peak flow for Stirling Vale Creek of 72 m^3/s at the Barrier Highway and 98 m^3/s at the Peterborough-Broken Hill Railway Line crossing.

In order to provide an estimate for the impact of a 100 year ARI event, being the usual design event, an application of a 50% increase in the 50 year ARI flows was used. This is considered to be a reasonable guide for an estimated 100 year ARI event, and appropriate for this concept design. The 50 year ARI is used in the following section descriptions for some of the highway waterway capacities. In other sections of this report we refer to an estimated 100 Year ARI event, which

refers to the 50 year ARI event flows increased by 50%. In future detailed design development, a rainfall runoff model could be developed to more accurately calculate a 100 year ARI event.

3.3. Hydraulic assessment

3.3.1. Backwater from Stirling Vale Creek

Hydrologic Engineering Center's River Analysis System (HEC-RAS) is a widely used computer program used to model hydraulics of water flow through natural waterways and channels. Stirling Vale Creek was modelled in HEC-RAS from the railway to the highway. Within this reach, the tributary from the site joins Stirling Vale Creek approximately 2.6 km from the railway line.

The modelling incorporated five cross sections for Stirling Vale Creek that were taken from the 20 metre DTM as well as multiple cross-sections from the creek system on the site using the 0.3 metre contours available within the site. The cross-sections from outside the site are not very accurate due to the coarseness of the DTM; however, at this stage of option assessment they were considered adequate. Future investigations for detailed design development may support more detailed hydraulic assessment for Stirling Vale Creek.

The HEC-RAS model was simulated for the 50 year ARI event and events 50% larger than the 50 year ARI (estimated 100 year ARI design event). A Manning's n value of 0.05 was used, which is representative of pasture / light brush covering that was observed during the site visit.

Modelling results indicated that flooding in Stirling Vale Creek does not result in elevated water levels at the site boundary.

3.3.2. Potential surging of culverts at the highway

Stirling Vale Creek flows underneath the Barrier Highway through a series of four box culverts (refer to **Table 2-1**). The maximum capacity of the culverts was estimated to be 76 m^3/s, which is higher than the 50 year ARI peak flow of 72 m^3/s generated by the catchment upstream from the highway. Flows in excess of this during a 100 year ARI event may flow over the road formation; however, based on the 90 metre DTM, surcharging water is not expected to be directed towards the site.

There is a small tributary of Stirling Vale Creek that crosses the highway from south to north approximately 400 metres from the north-eastern corner of the site. This tributary flows through two box culverts (refer to **Table 2-1**) underneath the Barrier Highway. Based on the 90 metre DTM, the 50 year ARI peak flow was estimated to be almost 14 m^3/s, which is the capacity of the two box culverts. This assessment indicates that flow will not overtop the road for the 50 year ARI event or less. However, in the case of a larger 100 year ARI event, there is a potential for flow to surcharge and flow west towards Stirling Vale Creek near the site. The 90 metre DTM indicates

that this potential overflow is unlikely to flow into the site as topographic gradient is predominantly east-west rather than to the south.

4. Site Drainage

4.1. Identification of drainage areas

As shown in **Figure 4-1**, the majority of the site represents an internal catchment that drains 98 hectares to a farm dam located on the north-west boundary of the site. Smaller catchments and channels drain to the eastern, southern and western site boundaries. The portions of the site that drain to the various site boundaries was previously discussed in **Section 2.3.1** and **Table 2-2**.

Typical drainage on the site is overland sheet flow that combines and results into small incised channels (typically 0.3 to 0.5 metres deep), except where runoff accumulates in the vicinity of the farm dam. At this location, water depths are greater.

4.2. Estimation of design discharges

The Probabilistic Rational Method, as used for the Stirling Vale Creek catchment (refer to Section 3.2), was used to estimate design flows for sub-catchments within the site. The peak flow for the estimated 100 year ARI was calculated for sub-catchments shown in **Figure 4-1**. The estimated peak 100 year ARI flow is 14.4 m^3/s.

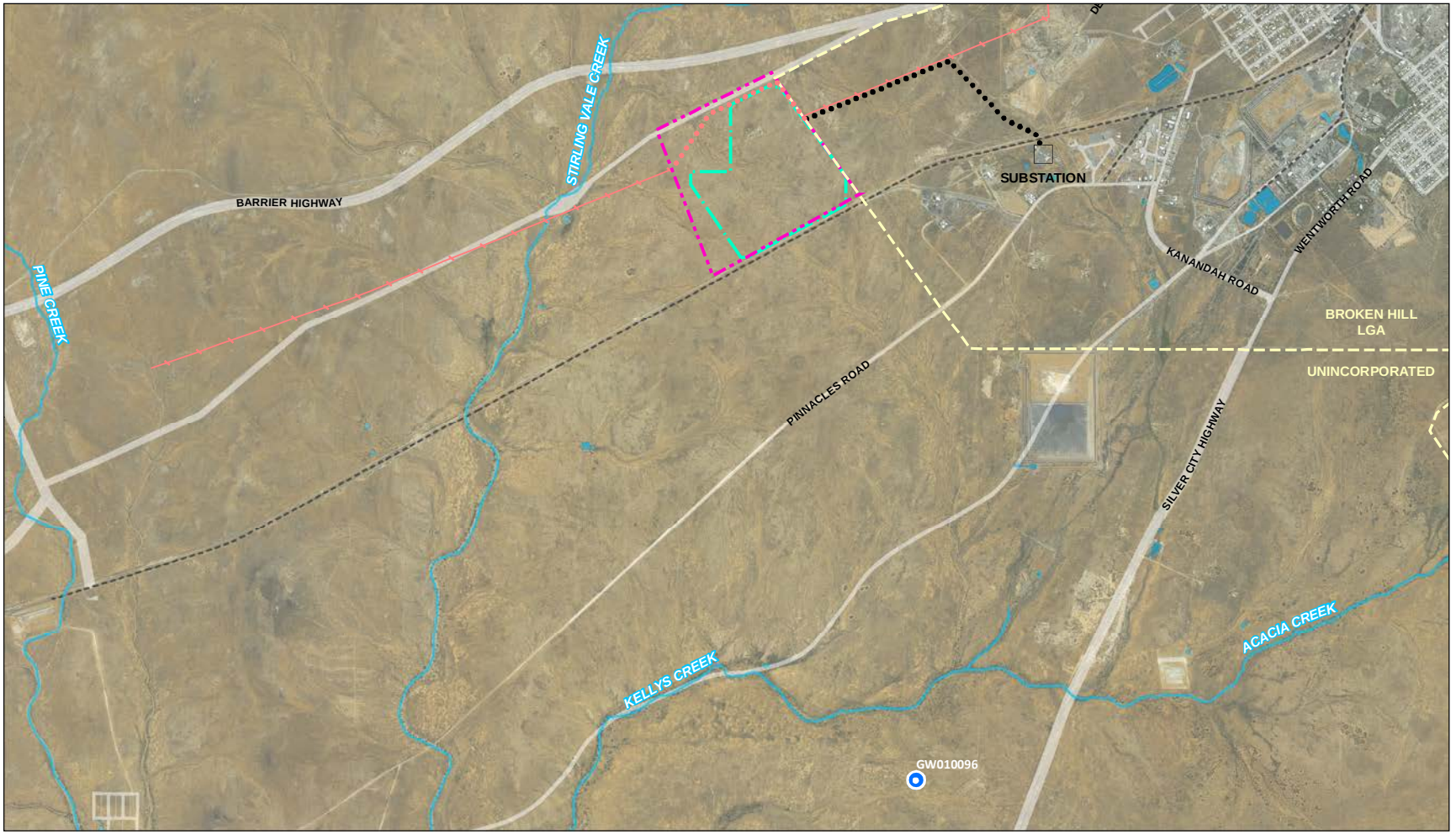


Figure 4-1 Drainage Areas and Major Overland Flow Paths

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Spatial Team - Prepared by : JC
Checked by : JL

4.3. Flood depths and flood extents

4.3.1. Minor drainage lines

Smaller catchments and channels drain to the eastern, southern and western site boundaries as shown in **Figure 4-1**. Flow depths at these locations were estimated with Manning's equation using a Manning's n value of 0.05 (consistent with a Manning's n value for floodplains with pasture / light brush covering). Cross-sections were extracted from the 0.3 metre contour data and peak discharges previously calculated with the Probabilistic Rational Method were used. Based on these inferred flow depths and given the mildly sloping topography, it is estimated that areas within the site away from the major overland flow paths would experience shallow sheet flow.

Estimated depths of up to 0.3 metres have been assessed at the site boundaries.

4.3.2. Major drainage lines

Major overland flow paths within the site were modelled in HEC-RAS to estimate flood depths and extents in an estimated 100 year ARI event. A Manning's n value of 0.05 was used (consistent with a Manning's n value for floodplains with pasture / light brush covering) for the banks and the overland flow paths. This was considered to be appropriate as it is anticipated that the site will remain vegetated during operation of the PV plant.

Flow velocity in the major overland flow paths varies between 0.2 and 1.2 m/s, with an average of 0.7 m/s. The maximum velocity occurs in the centre of the site.

The modelled extents and depths of flooding within the Broken Hill site for the estimated 100 year ARI event are shown in **Figure 4-2**. The depth within the three main drainage channels varies from 0.1 to 1.2 metres. From the analysis, the estimated area that experiences flood depths greater than 0.5 metres is only approximately 0.7 % (1.2 ha) of the site area and 0.4 % (0.6 ha) of the PV plant area. The area experiencing flood depths between 0.25 and 0.5 m depth is approximately 1.8% (3.1 ha) of the site area and 1.7% (2.2 ha) of the PV plant area.

It can be seen from **Figure 4-2** that while the site may be affected by flooding during an estimated 100 year ARI event, the flooding is confined to the three main drainage lines within the site and the farm dam.

The preliminary flooding analysis presented in this report uses daily rainfall data as is recommended by national flooding analysis guidelines (Australian Rainfall Runoff (ARR)). It should be noted that since the region is subject to infrequent, high intensity, short duration events (in the order of hours), then additional analysis should be undertaken during the detailed design phases of this project. While such events are infrequent, there is a low risk that such storms may lead to higher velocities and larger depths than those estimated in this report. It is recommended

that future analysis during the detailed design phase include a rainfall-runoff modelling approach that uses pluviograph rainfall data (6 minute interval data) to refine flooding estimates for these infrequent events. This is also important in relation to assessing potential for soil erosion during such intense rainfall events.

4.4. Conclusions

Typically, drainage on the site is shallow, overland sheet flow that combines into small incised channels (typically 0.3 to 0.5 m deep). The majority of the site drains to the farm dam, which is located on the northwest boundary of the site. Smaller catchments and channels drain to the eastern, southern and western site boundaries. There are three main drainage channels that flow into the farm dam for which hydraulic modelling was undertaken to estimate flow depths, velocities and extents.

The depth within the three main drainage channels varies from 0.1 to 1.2 metres, and velocities vary between 0.2 and 1.2 m/s with an average velocity of 0.7 m/s. It is recommended that the erosion potential of the local soils be assessed in the future detailed design phase in relation to the proposed vegetation cover.

Inundation greater than 0.5 metres is estimated to cover approximately 0.7 % (1.2 ha) of the site area and 0.4 % (0.6 ha) of the solar PV plant area. The deepest water will occur at the farm dam (2.4 metres). Inundation between 0.25 and 0.5 metres is estimated to cover approximately 1.8% (3.1 ha) of the site area and 1.7% (2.2 ha) of the PV plant area.

From this study, the flood impacts (in terms of areas subject to varying depths of flooding and flow velocity) within the site in an estimated 100 year ARI event are not expected to be a restriction to the solar PV plant.

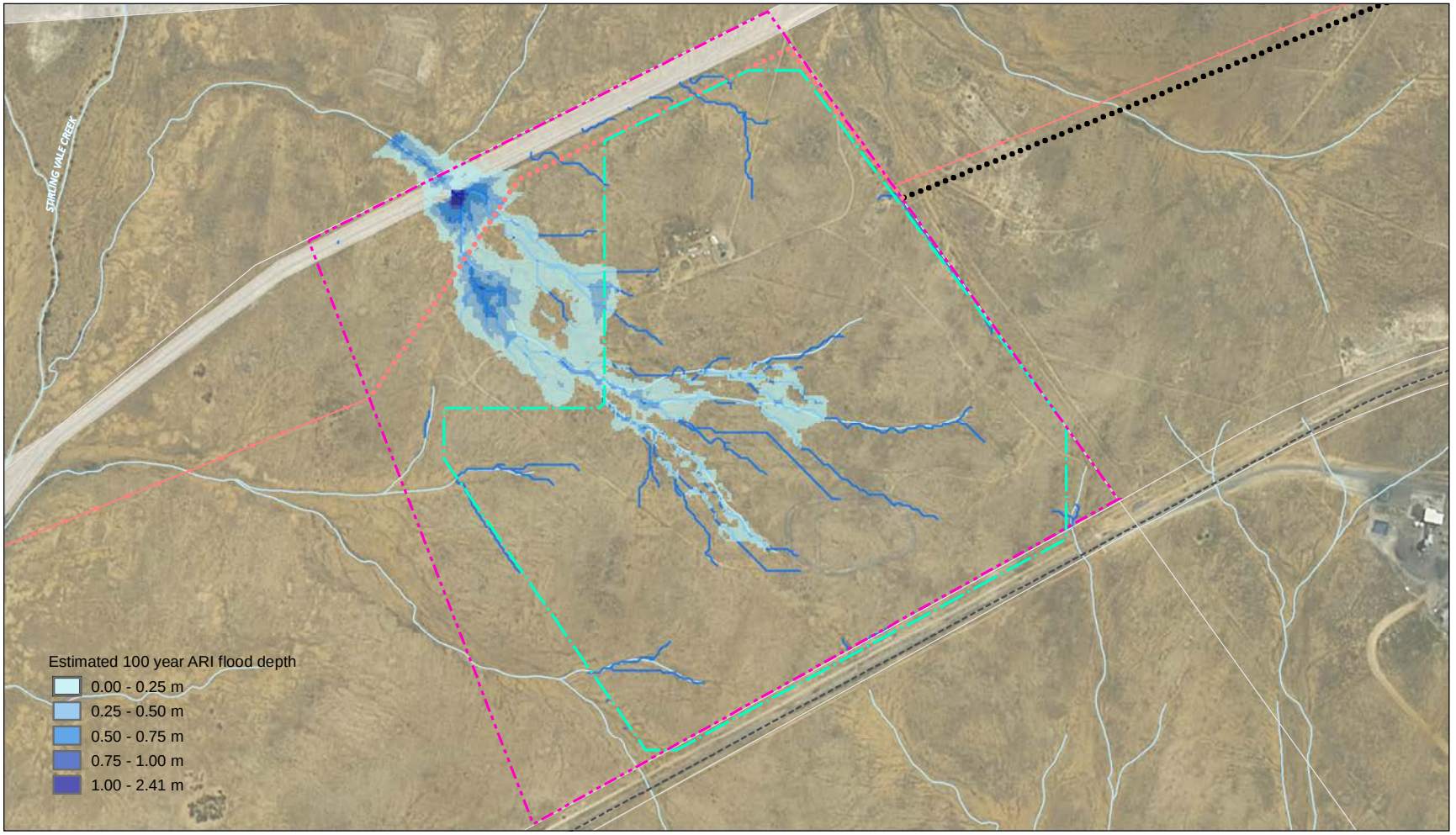

Figure 4-2 Extent and Depths of Flooding along Major Overland Flow Paths

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Spatial Team - Prepared by : JC
Checked by : JL

- **Potential Stormwater Erosion**

The solar PV plant construction would involve PV panels supported by poles that are thrust into the ground. Access roads and buildings will be minimal. Any potential soil erosion and sediment impacts during construction can be mitigated through procedures in the construction environment management plan (EMP).

It is expected that the change of land use on the site would result in loss of vegetation cover. This has the potential to result in increased soil and water erosion. Mitigation and management measures would include:

- Adopt vegetation types suitable for soil types, climatic conditions and shaded areas under the panels.
- Ensure works maintain sheet flow and do not concentrate flow which potentially would increase erosion.
- Develop a monitoring and maintenance program.

5. Conclusion

A preliminary hydrology assessment was undertaken to determine the impact of flooding on the proposed solar PV plant. The site has a small local catchment draining to the north-west of the site towards Stirling Vale Creek. Stirling Vale Creek runs to the north and the west of the site.

Stirling Vale Creek does not have any streamflow gauging stations, and no information is available for past flood events. Thus the flood assessment was undertaken based on industry accepted procedures. It is recommended that in future design development, a rainfall runoff model could be developed to more accurately calculate a 100 year ARI event.

For the mainstream flooding assessment, the Rational Method was used to determine peak flows from Stirling Vale Creek. The modelling showed that the site is not expected to be impacted by such mainstream flooding.

Typically drainage within the site is shallow, overland sheet flow that combines and results into small incised channels (typically 0.3 to 0.5 metres deep). The majority of the site drains to the farm dam which is located on the northwest boundary of the site. Smaller catchments and channels drain to the eastern, southern and western site boundaries. There are three main drainage channels that flow into the dam for which hydraulic modelling was undertaken to estimate flow depths, velocities and extents. The depth within these main drainage channels varies from 0.1 to 1.2 m and velocities vary between 0.2 and 1.2 m/s with an average velocity of 0.7 m/s. It is recommended that the erosion potential of the local soils be assessed in the future detailed design phase in relation to the proposed vegetation cover.

Inundation greater than 0.5 metres is estimated to cover approximately 0.7 % (1.2 ha) of the site area and 0.4 % (0.6 ha) of the solar PV plant area, with the deepest water at the farm dam (2.4 metres). Inundation between 0.25 and 0.5 m is estimated to cover approximately 1.8% (3.1 ha) of the site area and 1.7% (2.2 ha) of the solar PV plant area.

From this study, the flood impacts (in terms of areas subject to varying depths of flooding and flow velocity) within the in an estimated 100 year ARI event, are not expected to become a restriction to the proposed design of the solar PV plant at the site. It is recommended that a 0.5 m freeboard above the design flood levels be adopted in the design to protect critical assets of the solar PV plant from flooding in an estimated 100 year ARI event.

6. References

Australian Rainfall and Runoff (2001) *A Guide to Flood Estimation.*

Bureau of Meteorology (2010).

US Army Corps of Engineers (2008) *HEC-RAS, River Analysis System, User's Manual, Version 4.0*

Appendix H Notification of EA Application

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Paul Seager
PO Box 788
Broken Hill NSW 2880

31 March 2011 *HA01345*

Dear Paul,

Broken Hill Solar PV Project (EA application reference 10_0187) - Agency Consultation

AGL Energy Limited (AGL) has proposed to construct and operate a 50 megawatt (MW) solar photovoltaic (PV) power plant at Broken Hill in New South Wales as part of its Round 1, Stage 2 application to the Commonwealth Solar Flagships Program.

The Solar Flagships Program is part of the Australian Government's $4.5 billion Clean Energy Initiative, announced in the May 2009 Budget. The Government's aim is to establish up to 1000 MW of large-scale solar power generation capacity. AGL has proposed the Broken Hill Solar PV Project as part of its Round 1 application to the program.

AGL is seeking Project Approval for the development of the proposed 50MW solar project. The proposed development will include the installation and operation of a twin circuit 22kV overhead transmission line, approximately 2.7 km in length, to connect the PV plant to the Broken Hill substation.

A description of the project and the relevant environmental issues is provided in the Preliminary Environmental Assessment (PEA) which is available through the Department of Planning website at the following address: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4367).

The project will be assessed under the provisions of Part 3A of the NSW *Environmental Planning and Assessment Act 1979*. AGL lodged a project application and PEA with the NSW Department of Planning in November 2010. The Director-General's requirements for the Environmental Assessment were issued on 8 December 2010, and are attached for your information.

By means of this letter we are seeking input from your agency to support preparation of the Environmental Assessment for the project. If you have any specific issues you wish to be

considered within the Environmental Assessment, we would be happy to discuss this with you further.

Yours sincerely

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