

AGL

Broken Hill Solar Plant

ENVIRONMENTAL ASSESSMENT

Volume 6 – Appendix D to Appendix E

October 2012

SINCLAIR KNIGHT MERZ

Appendix D Noise and Vibration Assessment

BROKEN HILL SOLAR POWER PLANT– ENVIRONMENTAL ASSESSMENT

NOISE ASSESSMENT

BROKEN HILL SOLAR POWER PLANT– ENVIRONMENTAL ASSESSMENT

NOISE ASSESSMENT

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Contents

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
0	6th July 2011	B Ison	S Hughes	22 March 2011	Draft
1	24 August 2012	J Lazorov	B Ison	6 Sept. 2012	Final

Distribution of copies

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

Printed:	16 October 2012
Last saved:	20 September 2012 11:14 AM
File name:	I:\HARB\Projects\HA01678\Technical\Noise\Appendix D_ Noise Assessment_BI.docx
Author:	Ben Ison
Project manager:	Peter Faggion
Name of organisation:	Solar Flagships (AGL)
Name of project:	Broken Hill Solar Plant Project
Name of document:	Noise Assessment
Document version:	Final Draft
Project number:	HA01345.227

1. Noise assessment

1.1. Existing noise environment

The Broken Hill Solar Power Plant is proposed to be located in an area of native scrubland approximately 5 km south-west of the town of Broken Hill, located on the Barrier Highway in western NSW. The existing noise environment in the area is primarily influenced by traffic on the Barrier Highway, in particular the numerous heavy vehicles and road trains passing the location. The main east-west rail corridor is located along the southern site boundary; the Indian Pacific and Outback Explorer train services operate along this route in addition to freight and ore services.

The Bemax Mineral Separation Plant is located approximately 2.5 km to the east of the site. This processing plant operates throughout the 24 hour period and is audible at the project site during evening hours when meteorological conditions are conducive to the transmission of noise.

1.1.1. Sensitive receivers

The proposed location of the solar PV plant is located in a sparsely populated rural area. A single residential property is located on the proposed project site, however as this property will be vacated prior to the start of construction, it has not been discussed in this assessment. A second residential property is located 1.3 km to the west of the project site on the Barrier Highway. No other noise existing sensitive receivers are located in the vicinity of the primary work site.

In addition to the solar PV plant, the project will also require the construction of a 2.7 km overhead transmission line which will connect the solar array with an electricity sub-station located on the south-western outskirts of Broken Hill. A single residential receiver is located approximately 970 m north-east of the line on the Barrier Hwy. A further two receivers are located approximately 1 km south of the electricity sub-station on Pinnacles Road, approximately half way between the sub-station and the Bemax plant.

In addition, numerous light industrial businesses are located on the western outskirts of Broken Hill, approximately 1.5 km from the proposed solar PV plant, and within 1 km of the transmission line. Residential areas of Broken Hill are located approximately 3.7 km to the north east of the solar PV plant site.

A summary of relevant details for these receivers is presented in **Table 1**, and graphically on **Figure 1** Note any maps/figures/tables shown in this report are indicative only and subject to detailed design.

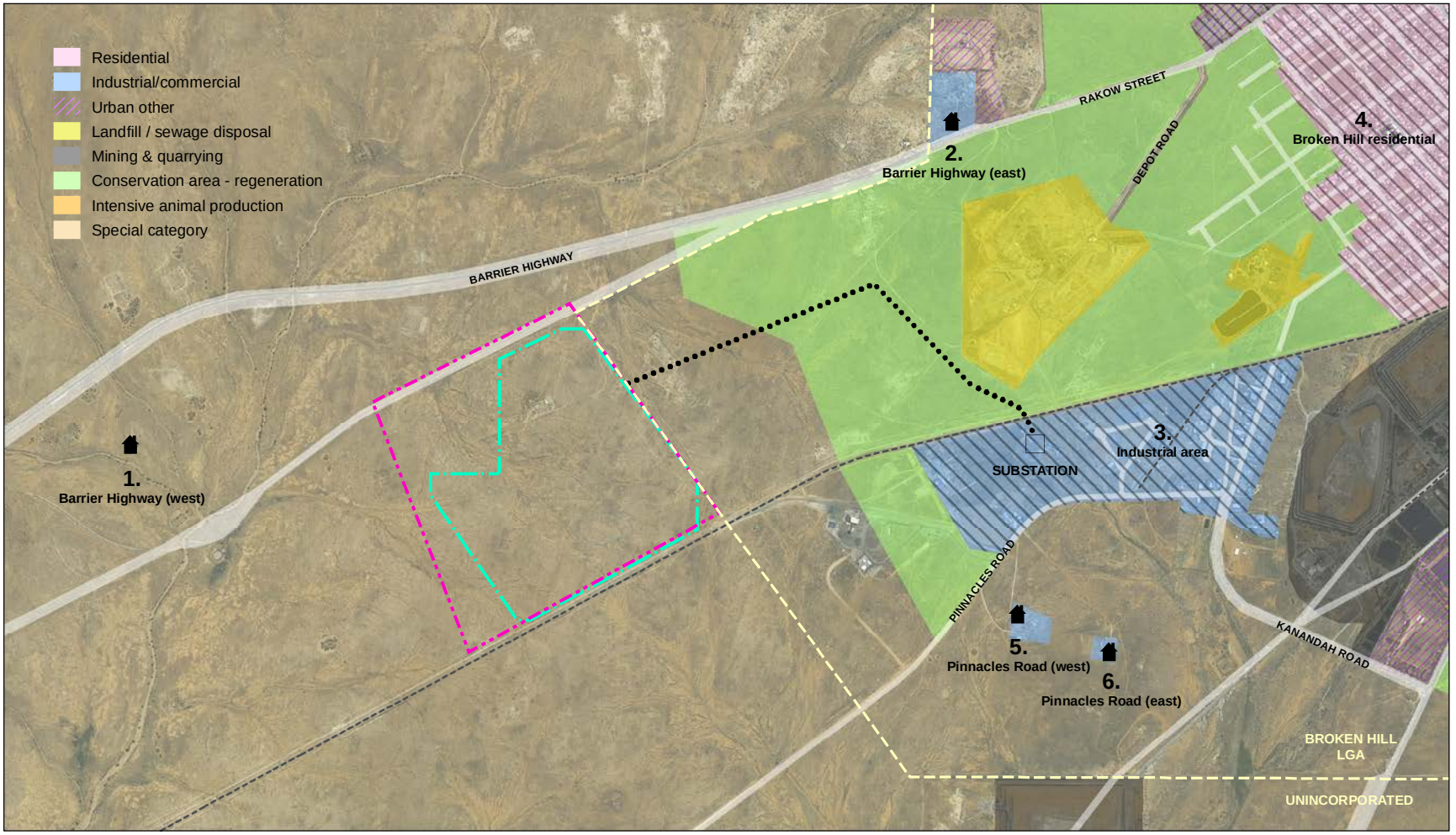

Figure 1 Site layout and sensitive receivers

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Spatial Team - Prepared by : JC
Checked by : JL

- **Table 1 Summary of sensitive receivers**

Receiver	Distance - Solar Array (m)	Minimum Distance - Transmission Line (m)	Land-use	Lot/DP
1 - Barrier Hwy (West)	1,300	2,750	Residential	6633 DP769414
2 - Barrier Hwy (East)	2,300	970	Residential	2844 DP764978 / 700
3 - Industrial Area	1,200	400	Industrial / Commercial	na
4 - Broken Hill Residential	3,700	1,900	Residential	na
5 - Pinnacles Road (East)	2,250	1,250	Residential	11 DP757304 / 119
6 - Pinnacles Road (West)	1,800	1,000	Residential	9 DP757304 / 121

1.1.2. Noise monitoring results

Existing, ambient noise levels were monitored between the 7 December and 10 December 2010. The survey was conducted at the residential property on the project site, and is considered representative of nearby rural residences where potential noise impacts may be experienced. These noise levels will also be used in the assessment of noise within Broken Hill itself, however given that the township is likely to experience substantially higher noise levels, the results of this monitoring are considered conservative. The results of the background noise testing are included in **Table 2** below.

During this period unattended monitoring was carried out using ARL noise loggers collecting 15 minute noise statistics. Calibration of the unit was checked before and after monitoring, and a drift of less than 0.5 dB(A) was noted. Complete results of noise monitoring are contained in **Appendix A**.

- **Table 2 Background noise monitoring results**

	L_{A10} (dBA)	L_{Aeq} (dBA)	L_{A90} (dBA)
Day	39.5	39.5	28.8
Evening	43.9	41.7	31.8
Night	41.0	38.8	29.6

1.1.3. Meteorology

The area of Broken Hill experiences a desert climate, with cold, dry winters and generally hot and dry summers. Typical wind patterns show a predominance of north to north easterly winds throughout the year.

The Bureau of Meteorology (BoM) maintains an automatic Meteorological Station at Broken Hill Airport, approximately 7 km south east of the project location, and this site has been judged as providing the most suitable meteorological observations to enable the validation of the unattended noise monitoring data. Data recorded during periods of rainfall and when the wind speed was greater than 5 m/s was removed from the analysis according to the procedures outlined in *AS1055.1-1989 – Acoustics -Description and Measurement of Environmental Noise*. These time periods are highlighted on the noise graphs contained in **Appendix A**.

Overall, the results of ambient noise monitoring indicate that the area surrounding the proposed upgrade works is a very quiet, rural environment, with typical L_{Aeq} noise levels of approximately 40 dB(A) throughout a 24 hour period. Noise levels generally increase during the evening and night time period, likely due to increased afternoon wind and evening heavy vehicles on the Barrier Hwy.

1.2. Noise legislation

1.2.1. Industrial noise policy

The Department of Environment, Climate Change and Water (DECCW) provides guidance for industrial noise impacts in the N*SW Industrial Noise Policy* (INP) (EPA, 2000). This document provided the framework and process for deriving the noise limit for assessment purposes and requirements for consents and licences that are used to regulate premises scheduled under the *Protection of the Environment Operations Act, 1997.*

The procedure specifies that there are two criteria for environmental noise that require assessment. The first relates to the intrusiveness of a noise source, and allows for the noise under assessment to be a margin above the background, whilst the other procedure relates to the acceptability of the resulting noise, in relation to the use of the surrounding landscape. Generally the more stringent of the amenity or intrusive criteria will define the appropriate criteria for a project.

The assessment of noise is complex and subjective. The EPA advocates that the assessment procedure should not be considered in isolation from other social and economic aspects of a development.

Intrusive Noise Criteria

To categorise the range in the background noise levels that prevail from day to day, the INP recommends that 15 minutes of ambient noise monitoring be undertaken for those times when the development would be operational. The monitoring should be undertaken at the most affected noise sensitive location.

A noise source will be deemed to be non-intrusive if the L_{Aeq} (15 min) noise level of the development does not exceed the Rating Background Level (RBL) by more than 5dB(A). The RBL is the median of the measured L_{A90} noise level during the day, evening and night periods during periods when the development is not in operation.

The project intrusive noise objectives are therefore set out in **Table 1-3** below, these results being 5dB(A) above the L_{A90} background noise level obtained during monitoring of existing noise levels. Given that RBL noise levels at the two monitoring locations are similar, the lowest monitored noise level during each period will be used for the assessment of noise criteria. Where monitored noise levels are below 30dB(A), the INP instructs that the existing background noise level is set to 30dB(A).

- **Table 1-3 Project Intrusive Noise Level Objectives**

Period	Monitored L_{A90} Noise Level – dB(A)	Intrusive Allowance – dB(A)	Intrusive Noise Criteria – L_{Aeq} dB(A)
Daytime	30	+5dB(A)	35
Evening	32	+5dB(A)	37
Night time	30	+5dB(A)	35

Amenity Noise Criteria

The amenity noise criteria applicable are defined by the Acceptable Noise Levels (ANLs) listed below (Table 2.1 of the *EPA Industrial Noise Policy*). In the selection of these criteria, residential receivers have been defined as 'rural residential'. This classification is based on existing noise in the immediate surrounding area. The defined recommended noise levels have been given in **Table 1-4**:

- **Table 1-4 Amenity Noise Criteria – Acceptable Noise Levels**

Receiver Type	Time of Day [a]	Recommended L_{Aeq} Noise Level dB(A)	
		Acceptable	Recommended Maximum
Rural Residence	Day	50	55
	Evening	45	50
	Night	40	45

a- Day: 7:00 am – 6:00 pm, Evening: 6:00 pm – 10:00 pm and Night: 10:00 pm – 7:00 am periods.

Operational Noise Criteria – Derivation and Summary

A summary of the project noise criteria is given below in **Table 1-5**:

Table 1-5 Derivation of project specific noise criterion

Noise Criteria	Time Period [a]		
	Day	Evening	Night-time
Intrusiveness Criteria	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$
Intrusiveness Criteria	RBL + 5 dB(A)	RBL + 5 dB(A)	RBL + 5 dB(A)
RBL level	30 dB(A)	32 dB(A)	30 dB(A)
Project Intrusiveness Criteria	35 dB(A)	37 dB(A)	35 dB(A)
Amenity Criteria (Rural Residential)	$L_{Aeq\ 11hr}$	$L_{Aeq\ 4hr}$	$L_{Aeq\ 9hr}$
Acceptable Amenity Criteria	50 dB(A)	45 dB(A)	40 dB(A)
Modified Amenity Criteria	-	-	-
Project Amenity Criteria	50 dB(A)	45 dB(A)	40 dB(A)
Project Noise Criteria	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$
All Locations	**35 dB(A)**	**37 dB(A)**	**35 dB(A)** [b]

a- Day: 7:00 am – 6:00 pm, Evening: 6:00 pm – 10:00 pm and Night: 10:00 pm – 7:00 am periods.

Given the continuous nature of operational noise sources associated with the project, the minimum criterion of 30dB(A) will be used for all time periods and all sensitive receivers.

Modification factors

Some noise sources contain elements that are considered annoying by members of the population. These may include features such as low frequency or tonal components of the noise. Where these features are present the INP imposes a penalty of 5dB(A) to the operational noise level. This corrected noise level is then considered against the normal project noise criteria.

1.2.2. Road traffic noise

Road traffic noise goals are identified from the DECCW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA,1999) guideline. These guidelines identify noise levels for noise sensitive receivers that are impacted by traffic noise on public roads. The noise guidelines specify absolute noise levels for daytime and night time periods. For the proposed solar project development the noise goals are taken from Table 1 of the ECRTN and are identified as item 7, *Land use developments with potential to create additional traffic on existing freeways/arterials*.

Road category	Daytime levels (7am-10pm)	Night-time levels (10pm-7am)
Item 7	$L_{Aeq\ (15hour)}$ 60 dB(A)	$L_{Aeq\ (9hour)}$ 55 dB(A)

It is expected that due to unattended operational nature of this type of plant, staff vehicle movements on a daily basis is would be minimal. The majority of traffic movements would be generated during the construction phase and to a lesser degree during the maintenance periods. A qualitative assessment of road traffic noise impacts has been included in **Section 1.3.2**.

1.2.3. NSW construction noise guidelines

The risk of adverse impact of construction noise within a community is determined by the extent of its emergence above the existing background noise level, the duration of the event and the characteristics of the noise. Impacts can then be exacerbated by the proximity of construction to residences or other sensitive land uses and the scheduled times of construction activities.

To address potential construction noise impacts the NSW Government has prepared an *Interim Construction Noise Guideline* (DECC, 2009). The guideline has been developed to assist with the management of noise impacts, rather than to present strict numeric noise criteria for construction activities.

Although not mandatory, the ICNG recommends standard hours for construction work as follows:

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

The ICNG describes two methods of assessing noise impacts from construction activities: the quantitative method, which is suited to major and complex construction projects; and the qualitative method, suited to short-term (less than three weeks) works undertaken during standard construction hours.

Construction of the project is anticipated to last for approximately 17 months and as such, a quantitative noise assessment has been carried out.

Table 6 outlines management levels for noise at sensitive receivers and how they should be applied. Restrictions to the hours of construction may apply to activities that generate noise at sensitive receivers above the 'highly noise affected' Noise Management Level (NML). The Rating Background Level (RBL[1]) is used when determining the NML. The RBL is the overall single-

[1] * In accordance with methodology outlined in the NSW INP, Section B1.3, where L_{A90} noise levels are monitored as below 30 dB(A), the RBL has been set to 30dB(A).

figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

- **Table 6 General construction NML**

Hours	Level	Description
Recommended Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected (RBL + 10 dB)	▪ The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, expected noise levels and the duration of activities. Contact details for a construction representative should also be provided.
	Highly noise affected (>75 dB(A))	▪ The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (RBL + 5 dB)	▪ A strong justification would typically be required for works outside the recommended standard hours. ▪ The proponent should apply all feasible and reasonable work practices to meet the noise affected level. ▪ Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should then undertake negotiations with the community. ▪ For guidance on negotiating agreements refer to Section 7.2.2 of the guideline*.

* DECC, 2009

For industrial premises located to the west of the project area, an external $L_{Aeq(15min)}$ noise limit of 75 dB(A) is prescribed.

Based on the measured noise levels described in **Section 3**, and the guidelines in **Table 6** above, the project-specific L_{Aeq} NMLs for each sensitive receiver have been determined and are presented below:

- Residential receivers 40 dB(A)
- Industrial receivers 75 dB(A)

1.3. Potential impacts

1.3.1. Operational noise assessment

General noise sources

There are several types of PV plant available for commercial implementation. Of the different types they may be further subdivided into tracking and non-tracking systems. Tracking systems involve the panels being driven by motors to track the arc of the sun through the sky to maximise the solar effect. The non-tracking type has a static array of panels and use no moving parts in the generation of the electricity.

The proposed solar PV plant at the Broken Hill s**i**te will be a fixed tilt system at 20 degrees from the horizontal (i.e. non-tracking) and therefore will involve no ongoing sources of mechanical noise from drive systems. Low levels of noise may be generated during routine maintenance activities; however as the specific activities involved in maintenance tasks are not known at this stage of the development, operational noise impacts due to maintenance activities should be addressed in a noise section of the operational management plan for the site.

Transformer noise

The site will require the operation of 42 x 1.4MVA transformers. Noise levels for these units have been calculated in accordance with Annex ZA – Specified sound levels for transformers as contained within *AS/NZS 60076.10:2009 Power Transformers Part 10: Determination of sound levels (IEC 60076-10, Ed.1 (2001) MOD)*. This document describes the method for determining the Standard Maximum noise level permitted for a transformer as:

- L_{WA}(Standard Maximum) = 66+ 14 log (MVA) dB(A)
- L_{WA} = 66 + 14 log (1.4) dB(A)
- L_{WA} = 68dB(A) per unit
- 42 units = 84dB(A) total L_{WA}

This calculation does not include any reductions due to enclosures or other noise attenuating features of the units, and as such represents a conservative analysis of potential noise impacts.

- **Table 7 Predicted operational noise levels**

Location ID	Construction Noise Criteria L_{Aeq} dB(A)	Distance (m)	Predicted noise level dB(A)
Barrier Hwy (West)	30	1,300	14
Barrier Hwy (East)	30	2,300	9
Industrial Area	30	1,200	14
Broken Hill Residential	30	3,700	5
Pinnacles Road (East)	30	2,250	9
Pinnacles Road (West)	30	1,800	11

These predictions of operational noise are based on distance attenuation only and do not include reductions which would occur as a result of air and ground absorption, and screening from topography and structures. As such they represent a conservative indication of noise impacts that may be associated with transformer noise.

The results of these calculations show that the transformers are expected to be inaudible at all sensitive receiver locations.

Modification Factors

Specific noise specifications for the transformer units are not available at this stage of the project. For the purposes of a preliminary assessment, a worst case scenario will be assumed where both tonal and low frequency noise penalties are incurred.

Under this unlikely scenario, a 10dB(A) penalty would be imposed onto the actual operational noise from the project. Consideration of the predicted noise levels contained in **Table 7** shows that even where this penalty is imposed, the maximum potential noise level would still comply with the criteria at the nearest sensitive receiver.

1.3.2. Traffic noise

Operational traffic noise

Operational traffic noise has been assessed using traffic data taken from Chapter 9 of the EA which identifies current traffic volumes for the Barrier Highway in the vicinity of the Solar PV plant. The Current AADT reported by the RTA for the Barrier highway, west of Broken Hill is approximately

466 vehicles. The expected maximum number of movements for the operation of the plant is 4 vehicles per day.

As an indication of the potential impact of traffic noise from the development, a doubling of the number of vehicles on the road would produce an increase of approximately 3 dB(A) at the nearest receiver locations. In comparison, the additional 4 vehicles generated by the proposal would create an imperceptible change in the existing noise levels. On this basis, no additional traffic noise mitigation is proposed for the project.

Construction traffic noise

Traffic noise generated during the construction phase of the project is expected to be limited to the daytime period only, in line with standard construction hours. The following daily traffic movements have been calculated as a likely maximum for the entire construction period and are based on traffic data contained in **Table 9-3** of the Environmental Assessment:

- Heavy vehicles 32 per day
- Light vehicles 100 per day

Using the CoRTN traffic noise calculation methodology, and an average speed of 20 km/hr, traffic noise is predicted to be in the order of 28dB(A) at the nearest sensitive receiver. This calculation assumes soft ground surface and adverse meteorological conditions. A correction of +7dB(A) has been allowed for unsealed road surfaces.

This noise level complies with the construction noise criteria of 40dB(A). Where construction noise approaches the project criteria, traffic noise at this level would not contribute to cumulative noise levels.

1.3.3. Construction noise assessment

The proposed construction period for Broken Hill Solar Power Plant is expected to last approximately 17 months, during which time noise impacts may be encountered at the nearest sensitive receivers.

From a noise perspective, the project is basically comprised of three major construction stages. These stages an**d** the likely equipment required have been outlined below in **Table 8**. This table also contains estimates of noise emissions from general types of construction equipment, so as to allow the assessment of their potential for airborne noise to adversely impact on nearby residences, during the construction process.

- **Table 8 Noise related construction phase and equipment list**

Construction Stage	Estimated Equipment List	Typical Sound Power Level L_{Aeq} dB(A)
Stage 1 – Clearing and grubbing	Tree Mulcher Tracked Excavator with claw Dozer D8 Dump Truck	115 104 108 108
Stage 2 – Deliveries and assembly	Dump Truck Truck mounted crane Ratchet Gun (Air) Tracked Excavator	108 105 101 104
Stage 3 – Connection / Transmission lines	Dump Truck Truck Mounted Crane Ratchet Gun (Air) Bored Piling Rig	108 105 101 104

Using this noise data, the predicted noise levels during each construction stage have been calculated for the nearest receiver locations and have are provided in **Table 9**

Likely construction noise levels have been based on the CONCAWE noise attenuation algorithm, and calculated using the equipment shown in **Table 8**. Meteorological conditions have been assumed to be adverse, with a Met Class of 6 assigned to the calculations. The calculations do not consider the absorption of noise by local geography, structures or vegetation. In addition, it has been assumed that all equipment described below would be operating at the same time at the nearest point to the receiver. As most traffic will occur at the start and end of a day, the results also assume all vehicle movements will occur during a one hour period. As such these calculations should be seen as possible maximum noise levels, and may not be reached in actuality.

- **Table 9 Predicted noise levels from construction activities at key receivers**

Location ID	Construction Noise Criteria L_{Aeq} dB(A)	Predicted Noise Level - dB(A) L_{Aeq}		
		Stage 1 - Clearing	Stage 2 - Assembly	Stage 3 – Transmission Line
Barrier Hwy (West)	40	39	34	22
Barrier Hwy (East)	40	29	26	37
Industrial Area	70	40	35	48
Broken Hill Residential	40	21	17	28
Pinnacles Road (East)	40	30	26	34

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Location ID	Construction Noise Criteria L_{Aeq} dB(A)	Predicted Noise Level - dB(A) L_{Aeq}		
		Stage 1 - Clearing	Stage 2 - Assembly	Stage 3 – Transmission Line
Pinnacles Road (West)	40	34	29	37

The results outlined in **Table 9** indicate that noise generated during the construction of the solar PV plant is expected to comply with the construction noise criteria during all stages of construction at all receiver locations.

1.4. Vibration assessment

Construction activities have the potential to impact human comfort and the integrity of structures located in close proximity to works. In particular dynamic compaction, piling and hydraulic hammering generate high levels of vibration that may be transmitted to nearby receivers.

Likely potential impacts and associated distances for construction vibration have been set out below in **Table 1-10**.

- **Table 1-10 Potential vibration impacts**

Approximate distance	Comment on potential vibration impact
Less than 2m	Structural damage to services or building structures is possible, particularly as a result of continual vibration impacts and the use of hydraulic hammers.
Up to 10m	Annoyance as a result of use of bulldozer, compactor & vibratory roller is probable. Structural damage is possible.
10 - 20m	Low probability of human comfort impacts for most activities. Adverse comment as a result of the use of vibratory rollers is possible. Structural damage is unlikely.
20 - 30m	Reduction in human comfort as a result of hammering or heavy vibratory rollers is possible. Structural damage is unlikely.
30m+	Low probability of vibration impacts from earthworks.

The nearest residential receiver to the construction area is located at a distance of approximately 400m, and as no vibration intensive activities are proposed, vibration impacts are not expected to occur at receiver locations during construction.

1.5. Proposed safeguards

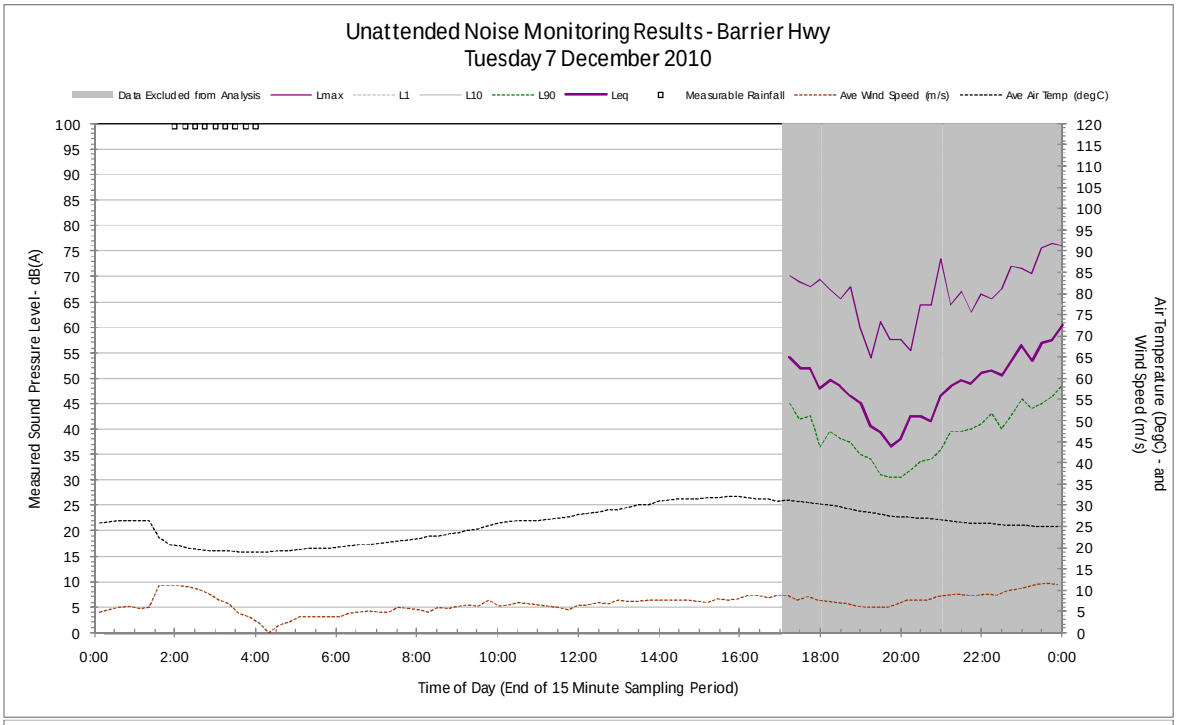
Due to the passive nature of the technology and the distance to the nearest noise sensitive receiver locations, no noise or vibration impacts have been predicted to occur during the operation or construction of the solar PV plant and associated transmission line, and as such there are no recommendations for mitigation measures.

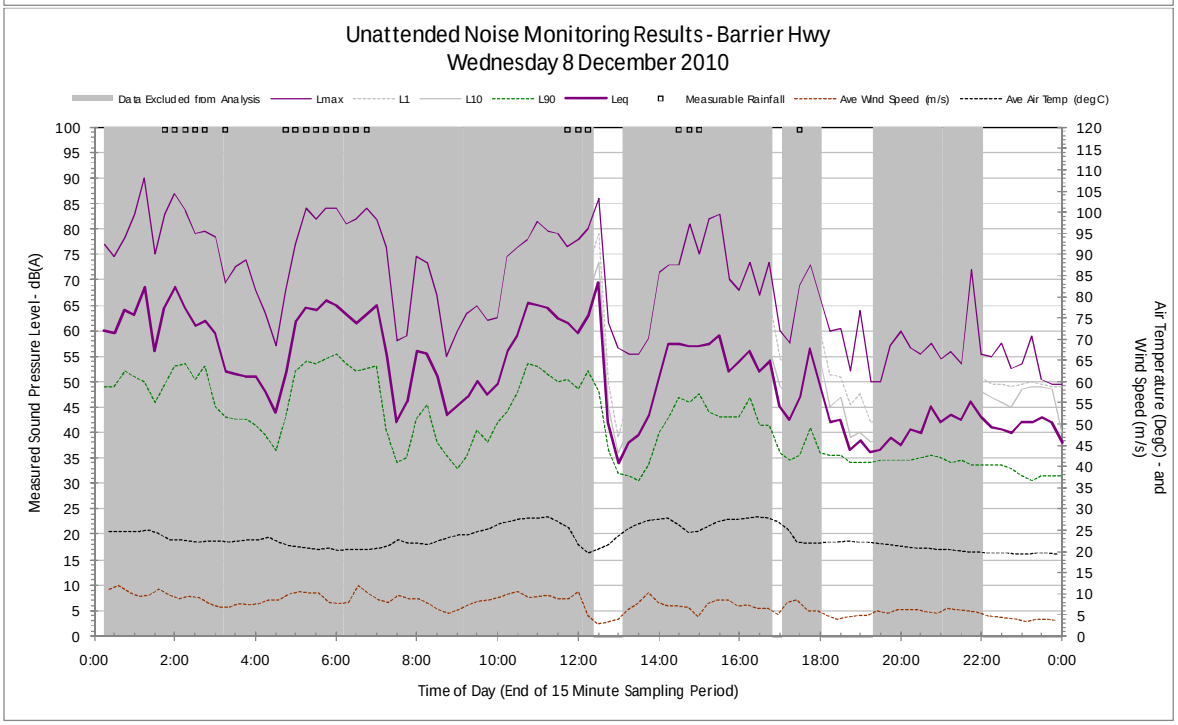
Whilst no impacts are predicted, noise controls should still be observed, particularly where construction methodologies do not conform to the construction stages presented in **Table 8** of this report. General consideration of noise should be considered as part of a best practice management of the site, which could include the following:

- Where both reasonable and feasible, restricting times when noisy work is carried out;
- Construction timetabling to minimise noise impacts - this may include time and duration restrictions and respite periods during noisy works, or the scheduling of particularly noisy activities in consultation with nearby sensitive receivers. This is considered important where work outside of the standard construction hours is proposed;
- The use of silencers and / or dampened tips on rock breakers if required;
- Selection of plant and equipment based on noise emission levels; and
- Use of alternative construction methods where noise impacts are expected.

Compliance noise monitoring should be undertaken to confirm the predictions of this assessment or in response to community complaints

Appendix A Noise Monitoring Results


Unattended Noise Monitoring Results - Barrier Hwy
Tuesday 7 December 2010
Data Excluded from Analysis
Lmax
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)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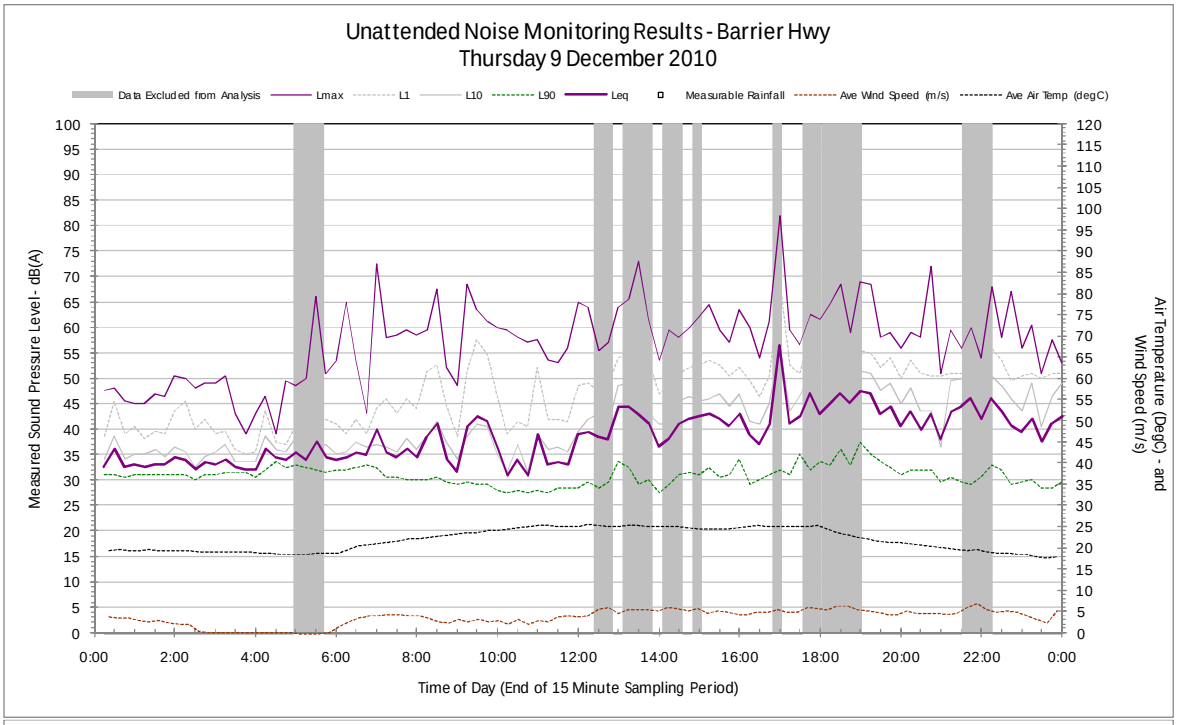
Wednesday 8 December 2010
Data Excluded from Analysis
Lmax
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)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Lmax
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L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
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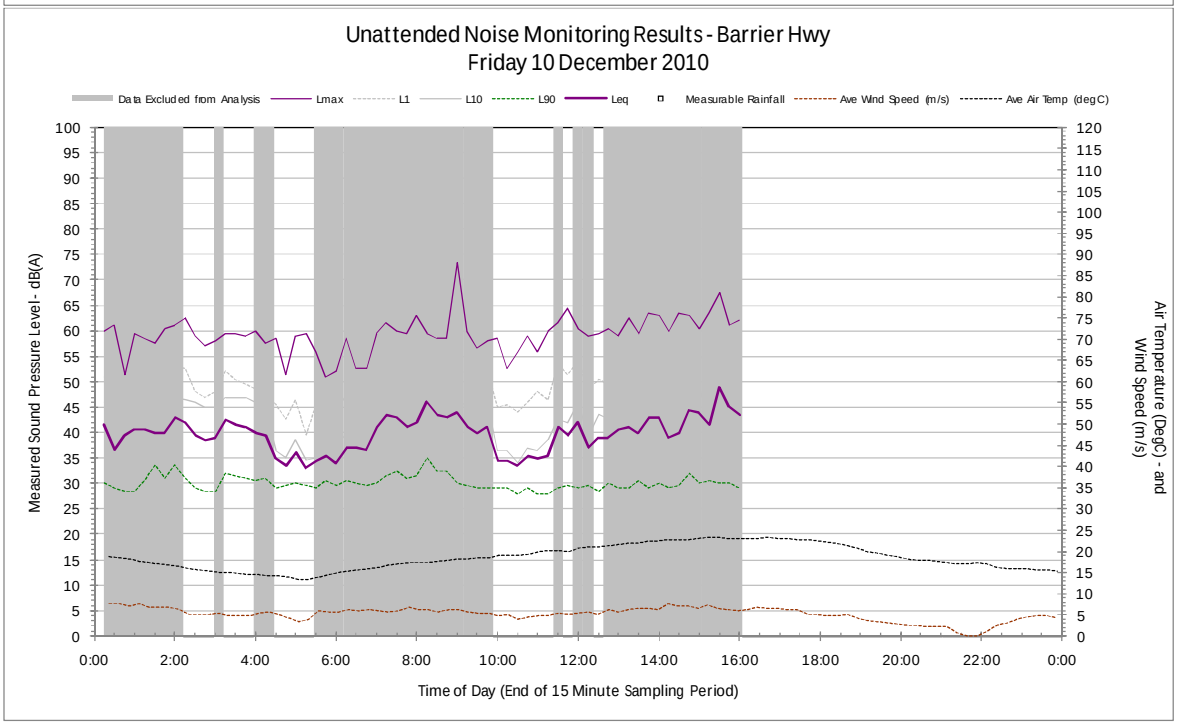
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)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L10
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Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

Appendix E Flora and Fauna Assessment

AGL Energy
Broken Hill Solar Power Plant

FLORA AND FAUNA ASSESSMENT

- Final report

AGL Energy
Broken Hill Solar Power Plant

FLORA AND FAUNA ASSESSMENT

- Final report

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Contents

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
Rev0	27/04/11	J.Harty	C.Thomson	27/04/11	Draft
	28/04/11	A.Hammond	C.Thomson	07/06/11	Professional Review
Rev01	6/08/2012	A.Callen	C.Thomson	6/08/12	Practice Review
Rev02	18/09/12	J.Lazorov	P.Faggion	19/09/12	Project Review

Distribution of copies

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Printed:	16 October 2012
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File name:	I:\HARB\Projects\HA01345\Deliverables\Reports\Environmental\NSW\Broken Hill\EA\Specialist Studies\Flora & Fauna\BrokenHill_SolarFlagship_Ecology_Rev0_Final.docx
Author:	Chris Thomson, Andrew Carty
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Name of organisation:	AGL Energy
Name of project:	Broken Hill Solar Plant
Name of document:	Broken Hill Solar Flagship Environmental Assessment – Biodiversity Assessment
Document version:	Final report
Project number:	HA01678

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1. Introduction

1.1. Preface

This assessment report provides an assessment of the ecological values and impacts associated with the proposed development of a photovoltaic (PV) solar project at Broken Hill in western New South Wales (NSW). The assessment is a specialist component of the project Environmental Assessment and identifies the flora and fauna potentially impacted by the project, presents an assessment of the significance of the impact and outlines required management measures to avoid and minimise impacts to biodiversity during construction and operation of the project.

1.2. Project Overview

AGL Energy Limited (AGL) is proposing to construct a solar PV plant with a nominal capacity of 50 MW at Broken Hill in western NSW as part of its stage 2 application to the Commonwealth Solar Flagships Program. The proposed project is to be located on a property to the west of the Broken Hill township approximately 200 hectares (ha) in area with additional areas of land required as a linear easement for the connection of the project's electrical infrastructure to the local grid system. The location of the site and alignment of the proposed easement required for the transmission line is provided as Figure 1-1. Note that any maps, figures or tables shown in this report are indicative only and subject to detailed design.

1.3. Scope of the Flora and Fauna Assessment

Key issues for the environmental assessment are identified in the Director-General's requirements that were developed in consultation with the Department of Planning and Infrastructure, the Office of Environment and Heritage (OEH) and the Lower Murray Catchment Management Authority (CMA). The specific requirements to be addressed in relation to ecology are described in Table 1-1, which also shows where these issues are addressed throughout the report.

- Table 1-1 Environmental assessment requirements relating to ecology

Environmental assessment requirement	Sections where addressed
Director Generals Requirements (Department of Planning and Infrastructure)	
Include an assessment of the impacts of all project components on flora and fauna (both terrestrial and aquatic, as relevant) and their habitat consistent with the *Draft Guidelines for Threatened Species Assessment* (DEC 2005) and taking into account the Western Catchment Action Plan (Western CMA 2007) and the Lower Murray-Darling Catchment Action Plan (Lower Murray Darling CMA 2008) including details on the existing site conditions and likelihood of disturbance (including quantifying the worst case extent of impact on the basis of vegetation type and total native vegetation disturbed).	Section 4, Appendix A and Appendix B

Environmental assessment requirement	Sections where addressed
Specifically consider impacts on threatened species and communities listed under both State and Commonwealth legislation that have been recorded on the site and surrounding land, impacts on riparian and/ or instream habitat in the case of disturbance to waterways, and on biodiversity corridors.	Section 4, Appendix A and Appendix B
Include details of how flora and fauna impacts would be managed during construction and operation including adaptive management and maintenance protocols (including the mitigation and/or management of weeds).	Section 5.3 and 5.4
Include measures to avoid, mitigate or offset impacts consistent with "improve or maintain" principles. Sufficient details must be provided to demonstrate the availability of viable and achievable options to offset the impacts of the project.	Section 4
Office of Environment and Heritage (formerly Department of Environment, Climate Change and Water (DECCW))	
The assessment of the proposal will need to consider direct and indirect impacts on threatened species and their habitat for the project site and the proposed transmission line. As a Part 3A development it is required to satisfy the requirements for flora and fauna impact assessment in accordance with the "*Draft Guidelines for Threatened Species Assessment*" under s75F of the Environmental Planning and Assessment Act 1979.	Section 4, Appendix A and Appendix B
The assessment of biodiversity in the EA should identify and map all vegetation on the site using the classification system identified in the NSW Vegetation Classification Assessment project. Note that native vegetation is not restricted to tree species but also includes native shrubs and ground cover species and that the vegetation presence on the site is likely to be native vegetation with the communities present likely to provide habitat for threatened species. A full list of threatened species known and predicted from the CMA subregion (Western Barrier Range) should be obtained.	Section 3.2, Appendix A
If any clearing is to take place, compensatory measures should be considered to maintain and improve habitat. Any revegetation program needs to have regard to the vegetation communities naturally occurring on site and the habitat requirements of flora and fauna, where applicable a detailed revegetation plan must be prepared and integrated into the development proposal.	Section 5.3
The EA should address the following:	
1. A field survey of the site should be conducted in accordance with the Department of Planning draft "Guidelines for threatened species assessment".	Section 2.2 and 3.2
2. Likely impacts on threatened species and their habitat must be assessed, evaluated and reported. The assessment should specifically report on the considerations listed in Step 3 of the draft guideline.	Section 4, 5 and Appendix B
3. Describe the actions that will be taken to avoid or mitigate impacts or compensate unavoidable impacts from the project on threatened species and their habitat. This should include an assessment of the effectiveness and any residual impacts after these measures are implemented.	Section 5.3
4. The EA should clearly state whether it meets each of the key thresholds set on Step 5 of the draft guideline.	Section 4.2

1.4. Legislative Context

The project is being assessed under Part 3A of the *Environmental Planning and Assessment Act* 1979 (EP&A Act). In addition, the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) has been considered in the assessment of the project.

Further state legislation relevant to the protection of biodiversity for the project includes the *Threatened Species Conservation Act* 1995 (TSC Act) and the *Fisheries Management Act* 1994 (FM Act).

Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) protects the environment, particularly matters of national environmental significance. It streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places. The EPBC Act identifies seven matters of national environmental significance:

- World Heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).

Environmental Planning and Assessment Act 1979

The EP&A Act details the development assessment system in NSW and this project is a critical infrastructure project under Part 3A of the EP&A Act. The consent and/or determining authority must consider the effects of a proposed development or activity on threatened species, populations and ecological communities as listed under Schedules 1, 1A and 2 of the TSC Act and determine if there is likely to be a significant impact. This document identifies matters which are relevant to the assessment of impacts to threatened species, populations, or ecological communities, or their habitats arising from the project under the *Guidelines for Threatened Species Assessment* (Part 3A) (DECC and DPI 2005).

Threatened Species Conservation Act 1995

The TSC Act identifies threatened species, populations and ecological communities as listed under Schedules 1, 1A and 2 which are to be addressed in assessing the significance of impacts arising from a project assessed by the EP&A Act.

Fisheries Management Act 1994

The objectives of the NSW FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. Objectives of the Act also include the conservation of fish stocks, key fish habitats, threatened species, populations and ecological communities of fish and marine vegetation. Any action that has an impact on threatened species, populations and ecological communities of fish and marine vegetation must be properly assessed to ensure conservation through the implementation of co-operative management.

1.5. Environmental Setting

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

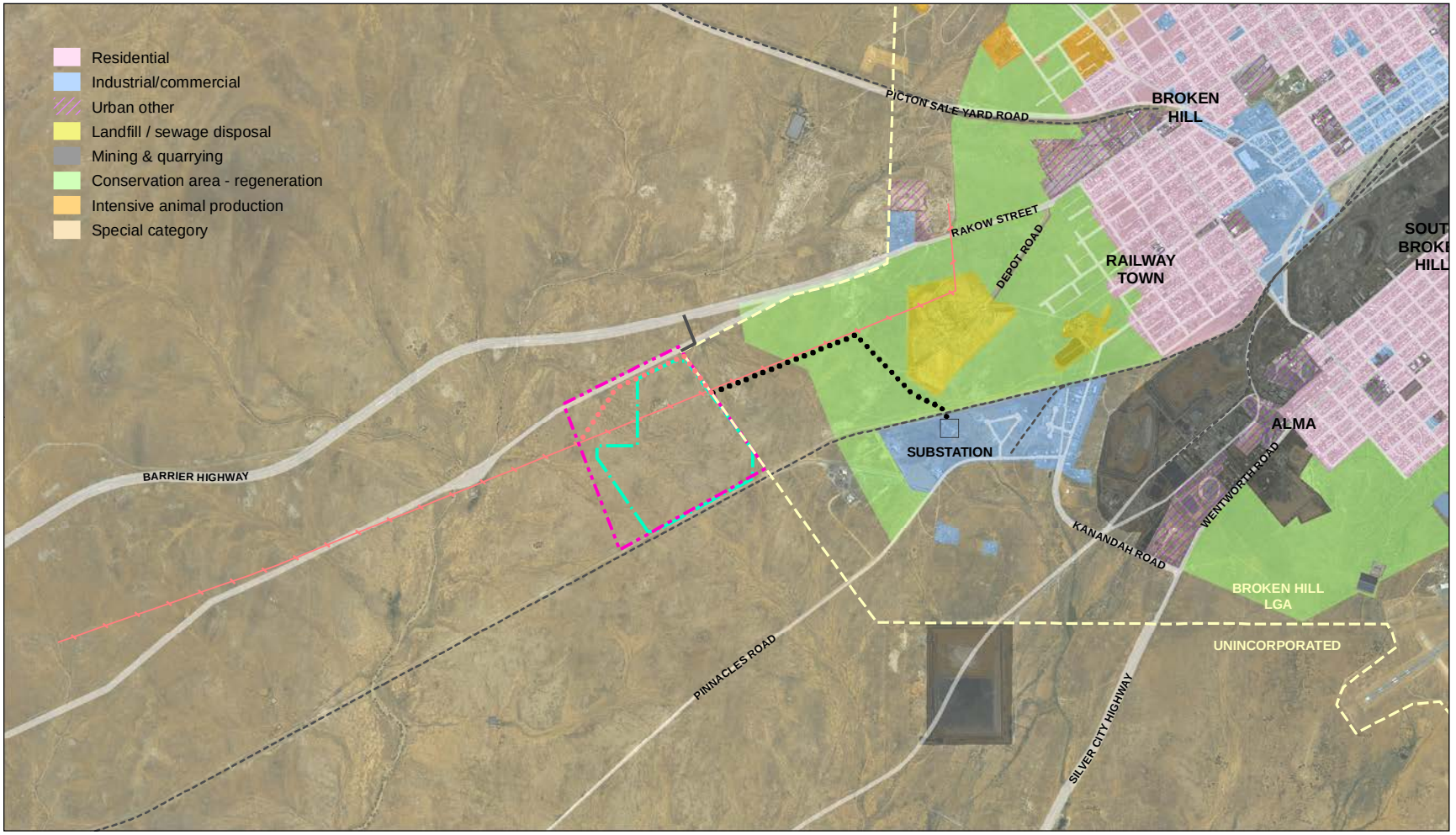

Figure 1-1 Overview of proposal

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Spatial Team - Prepared by : JC
Checked by : JL

2. Methods

2.1. Background review

The first stage of the assessment was a review of relevant background reports and government databases pertaining to the biodiversity of the bioregion and specifically the locality surrounding the study area. The literature and data reviewed included the:

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

A search for previous records of threatened species within the Atlas of NSW Wildlife was extended to a 25 kilometre radius of the site to account for the limited data and surveys conducted in the area. From the review a list of known and predicted threatened flora and fauna species was compiled and assessed to determine the potential presence of threatened biota in the study area. The list of potential subject species is provided in Appendix A in addition to an assessment of the likelihood of occurrence on the site based on the results of a habitat assessment and the site surveys.

2.2. Field survey and conditions

A field investigation was conducted to investigate the flora and fauna species and ecological values on the site with the objective of assembling quantitative and qualitative data on the flora and fauna diversity and the distribution of vegetation and habitat associated with the study area. The survey concentrated on the entire proposed development area and any adjacent habitats potentially impacted by the project. This included the main site for the PV array and the

transmission line easement from the site to the Broken Hill substation on the Willyama common land.

Terrestrial field surveys were undertaken between the 7 and 10 of December 2010, following relatively high rainfall in November 2010 (65.2 mm) more than three times the historical average for November (i.e. 20.7 mm). Additionally there was 3.4 mm of rainfall in December prior to fieldwork starting on the 7 December, and a there was a further 44 mm of rainfall during the survey period (7-9 December 2010). The extent of survey effort and techniques used for the detailed survey of the study area was conducted with reference to the *Draft Guidelines for Threatened Species Assessment* under s75F of the EP&A Act (DEC and DPI 2005) and *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* - working draft (DEC 2004). The early summer survey period and above average rainfall during spring/summer in Broken Hill at the time of the survey was optimum for detection of threatened flora. Flowering plants and live material is likely to have been present including seed heads (achenes) which would have been adequate to positively identify threatened species such as the Koonamore Daisy.

Field surveys were conducted under the National Parks and Wildlife Service Scientific Research Permit SL100044 and the Department of Primary Industries Animal Research Authority (09/1895). The personnel involved in the survey and compilation of the biodiversity assessment are detailed in Table 2-1.

- Table 2-1: Qualifications and experience of key personnel

Personnel	Qualifications	Experience and role
Chris Thomson	B App Sc; Grad Cert Nat Res	Chris is a Senior Ecologist and SKM's Practice Leader in Terrestrial Ecology with twenty years experience conducting fauna surveys. He has worked throughout NSW, Queensland, Victoria and Tasmania within a broad diversity of habitats from arid and mallee landscapes to heath, woodlands, sclerophyll forests and rainforests. His experience includes flora and fauna surveys, ecological monitoring, natural resource management and ecological impact assessment. He has extensive experience combining land-use planning with ecological management, including management of rare and threatened species and the provision of measures to mitigate impacts on flora and fauna. Chris prepared the biodiversity assessment report, fauna surveys and assessment.
Andrew Carty	B Env Sc; Dip Bush Regen	Andrew has nine years experience specialising in botany and flora ecology. His experience includes flora and fauna field survey design and implementation, species identification, habitat evaluation and assessment, weed management and natural resource management. Andrew has experience working in a diversity of ecosystems across a wide geographic range including temperate grasslands, arid landscapes, dry forests, heathlands, rainforests, wetlands and estuarine communities. Andrew is a qualified BioBanking assessor. Andrew prepared the biodiversity assessment report; conducted the flora survey and vegetation mapping.

Surveys were conducted on the terrestrial flora and fauna of the study area. Surveys for aquatic flora and fauna were not required given the absence of aquatic systems and habitat on the site and within immediate surrounds.

2.3. Limitations

The conclusions of this assessment are based upon available data and ecological surveys undertaken from a single season survey on the site and are therefore indicative of the environmental conditions at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. Where threatened species were not conclusively identified in the survey, this was supported by detailed habitat assessment to identify the species potential presence in the study area based on known and likely habitat components of the species. This was assisted by referring to Biobanking assessment tools (vegetation types database and threatened species profile database) that predict the presence of threatened species, both State and federally listed.

The survey timing was considered optimum for the detection of many of the expected species, with lower than average summer temperatures and wetter than average conditions. The assessment acknowledges some limitations and has adopted the precautionary principle.

2.4. Stratification

Aerial photographs, existing broad-scale vegetation mapping of the region, landscape data and topographic maps (1: 25,000) were used to stratify vegetation and habitats into individual units and identify appropriate sampling sites according to the extent of each unit. The stratification units are based on broad groupings of vegetation map units such as shrubland and woodland.

2.5. Flora survey

The survey aimed to provide baseline data on the presence of threatened species, populations and communities in the study area to provide a basis for the prediction of impacts and mitigation measures. The survey effort was determined through the stratification of the study area and the level of variability observed in each stratification unit. The survey focussed on identifying flora species impacted by the study area. The flora surveys utilised a combination of general traverses or transects, plot-based quadrat assessments and targeted surveys for threatened flora species.

Transects and traverses

Transect sampling was conducted in targeted areas to refine vegetation community boundaries in proximity to the footprint. The number of transects sampled was proportional to the size of the stratification units identified with up to two 100 m transects sampled per 2-50 ha of each stratification unit and three 100 m transects sampled per 51-250 ha of stratification unit as per guidelines in DEC (2004). A hand-held GPS unit was used to record vegetation community boundaries, the location of threatened species and any other items of interest such as habitat trees.

Digital mapping of vegetation community boundaries was conducted using the ArcGIS software package. A combination of field data, aerial photograph interpretation and biophysical data such as elevation and soil type was used to map the boundaries of vegetation communities. Description of the vegetation communities was based on their structure and dominant canopy species with reference to Specht (1981) and correlated with the NSW Vegetation Classification Assessment (Keith 2006). The vegetation identified on the site was cross referenced with the final determination advice provided for threatened ecological communities listed under the TSC Act by the NSW Scientific Committee (OEH 2011) and the Scientific Committee for the EPBC Act (SEWPAC 2011).

Plot-based surveys

Quantitative data on species richness was collected from quadrats (400m^2) replicated across each vegetation association. Quadrat data was used to determine the floristic composition and structure of vegetation associations, and the ecological condition of the vegetation including disturbances and weed abundance. Data collected in each sample plot included:

- Dominant species in each structural layer.
- Heights of structural layers (i.e. canopy, sub-canopy, shrub and groundcovers).
- A cover abundance score of each layer (based on a modified Braun-Blanquet cover scale).
- Landscape features (i.e. slope, gully, aspect etc).
- Soil features (soil type, rocks, organic matter etc).
- Geographical coordinates and a photographic record.
- Species richness and abundance.
- An inventory of all species in the plot.
- The presence and abundance of weed species.
- The condition of the vegetation including past and present disturbances such as fire, grazing, logging, etc.

- The presence, abundance and geographic coordinates of rare and threatened plant species.

The number of quadrats sampled was proportional to the size of the stratification unit and the degree of variation in the stratification unit. Additional to these quadrat assessments and general traverses, rapid plot-based assessments were undertaken recording dominant floristic species and vegetation structure to aid vegetation mapping. Any species that cannot be identified in the field were collected for later identification or for lodgement with the National Herbarium.

Targeted surveys

Threatened flora species that potentially occur in the study area were targeted in areas of suitable habitat. Targeted surveys comprised random meanders through areas of suitable habitat, which allows for greater coverage than plot-based techniques. Where threatened flora species are located, data was recorded on habitat condition, population size and range, reproductive status, existing threatening processes and habitat disturbances, age structure and land use. Threatened flora species were also recorded opportunistically during general traverses and quadrat assessments.

Vegetation condition assessment

Vegetation condition was broadly assessed within each of the vegetation communities, based on the degree of modification and disturbance observed in these areas. Considering the largely homogenous nature of the vegetation in the study area only three condition classes were established to assess the condition of the native vegetation. These condition classes comprise:

- High condition: Vegetation still retains much of the native species and structural characteristics of the pre-European equivalent. Such vegetation is usually in a near natural state with intact vegetation layers, a lack of soil disturbance and limited weed cover usually confined to edge habitats.
- Moderate condition: Vegetation generally still retains most of its structural integrity and/or diversity, but has been partially disturbed and has lost some component of its original species complement and/or vegetation structure. Weed invasion varies from slight to high.
- Low condition: Highly modified areas where most of the native diversity and vegetation structure has been lost. In the study area this condition class is confined to the cleared residential area of the site.

Further to this basic scale, a comparison of collected data with the biometric benchmarks (DECC 2008) database for the relevant vegetation communities as defined in the OEH Biobanking

Assessment Methodology was undertaken. As no formal biobanking plots were assessed on the site in accordance with the biobanking methodology, the biometric condition of each area of vegetation was determined or estimated from data collected during the general flora and fauna surveys, including vegetation plots and habitat assessments. The benchmarks for the vegetation types in the study area are provided below in Table 2-2.

- Table 2-2: Vegetation types and benchmark score used in the condition assessment (DECC 2008)

Biometric vegetation type in the study area	Native Plant Species Richness	Native Over-storey Cover		Native Mid-storey Cover		Native Ground Cover-grasses		Native Ground Cover-shrubs		Native Ground Cover-other		Number of Trees with Hollows	Total Length of Fallen Logs (m)
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (Benson 153)	11 species	0 % - grasslands 5% - chenopod shrubland	20%	0%	1%	1%	15%	0 % - grasslands 2% - chenopod shrubland	15%	0.5%	20%	0	0
Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone (Benson 136)	11 species	0%	0.1%	0%	0%	2%	20%	1%	10%	1%	20%	0	0
Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland of semi-arid and arid sandplains and dunes (Benson 143)	12 species	1%	14%	1%	8%	5%	25%	2%	15%	2%	25%	0	2
Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions (Benson 123)	17 species	0%	3%	1%	3%	1%	5%	1%	5%	1%	5%	0	3

2.5.1. Fauna and habitat survey

To assess the impacts on terrestrial fauna, comprehensive data was gathered in the field on the type, distribution and condition of the fauna habitats on the site in addition to a survey of fauna species. The survey was conducted over three days and covered the project site to the extent of the western boundary of the solar PV plant and proposed transmission easement up to 100 m along the easement corridor width as well as adjacent lands to the west of the development area.

The fauna survey and habitat assessment aimed to identify the fauna species and habitats that would be potentially impacted by the proposal. This included consideration of the extent and quality of native vegetation, including the location of unique or significant habitat areas. The disturbance history of the proposal impact area and the type and condition of any drainage lines present were also assessed. A particular focus of the survey was to assess the potential significance of the proposal to fauna species listed on Schedules 1 and 2 of the TSC Act, the FM Act and the EPBC Act, that were considered moderately or highly likely to occur (refer assessment Appendix A).

Fauna habitats are uniform across the site and were assessed by random sampling of 14 (50 x 50 m) plots and identifying typical habitat characteristics such as the structure and floristics of the vegetation, the structure of the micro-habitat in particular groundcover such as logs and shrub density, other artificial debris, litter and the presence of rocks or cracking clay provided cover for reptiles. Other microhabitat features considered important for feeding, roosting and breeding were identified such as wet habitats, tree canopy and keystone flora species.

Dedicated surveys for diurnal birds, mammals, amphibians and reptiles were conducted in addition to recording of signs of significant fauna. Given the size of the area and uniformity of the habitats the survey consisted of an area based survey of the proposed development footprint, recording active fauna species. Dedicated hand-searches were conducted where surface rocks or logs were encountered for sheltering reptiles, frogs and small mammals.

All opportunistic sightings of fauna were recorded through incidental sightings, identifying bird and frog calls and by observing indirect evidence of species presence such as scats, tracks, diggings, hair, feathers and animal bones. Raptor pellets and animal scats were collected from the site when encountered and these along with hair and bone samples were sent to Barbara Triggs for specialist identification.

The presence of fauna species in the study area was therefore determined through direct and indirect observation in addition to consideration of the known habitat preferences of targeted threatened fauna. In this way the field survey was based on the precautionary identification of habitat for threatened fauna species and the identification and adoption of protective strategies for features deemed likely to be critical habitat for threatened fauna.

3. Results

3.1. Background Review

The database searches included an area encompassing a 25 km radius of the study area to ascertain potential threatened flora and fauna species, endangered populations and ecological communities to occur. One endangered ecological community (TSC Act) *Acacia loderi* Shrublands (TSC Act) has been identified as being rare and at threat in the Broken Hill Complex bioregion, however the field survey confirmed that this community does not occur in the study area and will not be affected by the project.

Twelve threatened flora species and 36 threatened or migratory fauna have been previously identified or have been identified as potentially occurring within 25 km of the study area, including species listed as either endangered or vulnerable under the TSC Act and EPBC Act. The list of species is reported in Table 3-1 and Table 3-2 along with an assessment of the likely occurrence of these species in the habitats of the study area. The distribution of threatened species records is illustrated on Figure 3-1 and Figure 3-2.

- Table 3-1: Threatened flora species previously recorded from the locality

Threatened Flora	Status			Distribution and Habitat Requirements*	Habitat Suitability in Proposal Area
	EPBC Act	TSC Act	RoTAP*		
Acacia carneorum Purple-wood Wattle	V	V	3VCi	Occurs in the far western plains, south from west of Tibooburra to the Menindee area. Grows in grassland and woodland in red, sandy soil; also found in Mulga communities on sand dunes, level sandy sites and alluvial accumulations along watercourses; recorded from inland semi-arid *Acacia* and *Casuarina* shrublands and woodlands. Preferred soils are shallow, calcareous and loamy, and include brown earths, crusty alkaline soils and neutral red duplex soils; confined to red-earth dune soils in Kinchega NP as a dominant or occasionally co-dominant, usually on dune crests or slopes. Associated species include *Alectryon oleifolius*, *Casuarina cristata*, *C. pauper*, *Maireana pyramidata*, *Eucalyptus socialis* and *Enchyleana tomentosa*.	Moderate
Acacia notabilis Mallee Golden Wattle	-	E	-	Occurs west from Menindee in the far western plains of NSW. Early collections come from Byrnedale Station near Menindee and a locality south of Broken Hill. Known in Victoria from two locations in the central-north and north-west. Grows in mallee communities and open woodland on stony and rocky hills; soil types include brown lateritic loam, red clay-loam, shallow stony sands and red silty gravely sand. Associated species *include Eucalyptus camaldulensis, E. gracilis, E. socialis, E. calycogona, E. leptophylla, Melaleuca uncinata, Acacia spp., Sclerolaena diacantha* and *Beyeria opaca*. Grows as a lower open shrub layer within mallee shrubland, with an open shrub, herb and grass stratum.	Low

Threatened Flora	Status			Distribution and Habitat Requirements*	Habitat Suitability in Proposal Area
	EPBC Act	TSC Act	RoTAP*		
Acacia rivalis Creek Wattle	-	E	-	Recorded from the Broken Hill district, but originally found in SA, where described as being endemic and confined to the northern part of the Flinders Ranges region. There is a possibility that the species did not occur naturally in New South Wales but has become naturalised in a restricted area near Broken Hill. In NSW, confined to woodland communities bordering ephemeral creeks and streams and along watercourses. It grows in a variety of stony soils, often with limestone content. Associated species include *Callitris glaucophylla, Eucalyptus camaldulensis, Acacia victoriae, A. tetragonophylla, Hakea edniana* and *Eremophila spp.*	Low
Convolvulus tedmoorei Bindweed	-	E	-	Originally known from only two areas on the Murrumbidgee and Darling River floodplains in central-western NSW, from Toganmain Station, Darlington Point, and from a locality 5 miles NW of Louth. Two other recorded localities for the species are ENE of Broken Hill on the road to Wilcannia, and Menindee Road, Scarsdale. Grows in self-mulching grey clay soils on the floodplains of the Darling and Murrumbidgee Rivers.	Very Low
Dodonaea microzyga var. microzyga	-	E	-	Presently confined to the far north-western plains of NSW, where it is restricted to very localised occurrences at Peak Hill near Milparinka. Widely distributed in arid SA, extending into southern NT and Western Qld. Grows in arid open woodland or shrubland, mostly on stony rises, hills and ranges of ironstone and granite. Soils mostly skeletal and stony, including calcareous clay-loam, limestone soil and shaly soil. Associated species in central Australia include *Casuarina cristata, Eucalyptus socialis, Acacia sowdenii, A. kempeana, A. tetragonophylla* and *Eremophila* spp.	Moderate
Eleocharis obicis Striate Spike-sedge	E	E	3K	Found near Condobolin and Hay, as well as being known from an old collection from the Barrier Range near Broken Hill. The later collection was made on the Lachlan River floodplain at Micabil, near Condobolin. Grows in ephemerally wet situations such as roadside drains and depressions, usually in low-lying grasslands. Sites include depressions with heavy clay soils on the Lachlan River floodplain, with *Eragrostis australasica, Atriplex vesicaria and A. nummularia* shrublands, low-lying claypans near an irrigation channel, and a shallow open ditch on a low ridge with *Eucalyptus populnea* in red sandy soil over clay.	Moderate
Erodiophyllum elderi Koonamore Daisy	-	E	-	Occurs south from the Broken Hill district, at localities including Mazar Station south of Broken Hill and just east of the SA border. Also distributed throughout southern SA (including Koonamore Station, approx. 400 km NNE of Adelaide, from where the species gets its common name) and WA. Grows in flat open areas on sandy calcareous soils. In central Australia, it grows mainly on alluvial floodplains. Commonly recorded from Mulga shrubland with chenopods in SA and WA. Soils include red sand, brown clay, texture-contrast soil on a scalded floodplain, and red loam to sandy loam with quartz. Interstate habitats include stony plains, shallow creeklines over limestone, arid floodplains, and shallow depressions formerly filled with water. Associated vegetation includes *Acacia aneura* shrubland with *A. burkittii* and *Dissocarpus paradoxus*.	Moderate-High
Indigofera longibractea *Showy Indigo*	-	E	-	Restricted to an area just north of Broken Hill known as the Waukeroo Hills. Also occurs in SA at sites in the Musgrave and Flinders Ranges. Found on rocky hills and creek beds, growing in limited numbers in	Moderate

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Threatened Flora	Status			Distribution and Habitat Requirements*	Habitat Suitability in Proposal Area
	EPBC Act	TSC Act	RoTAP*		
				shallow stony soils among rock outcrops. Across its range it occupies a variety of rocky habitats, ranging from creeks to scree slopes and ridges. Soils are skeletal and sandy. Associated species and vegetation include *Acacia tetragonophylla, Callitris*, grass species dominated by *Triodia* and a diversity of low shrubs amongst granitic rocks.	
Lepidium monoplocoides Winged Peppercress	E	E	3ECi	Widespread in the semi-arid western plains regions of NSW. Collected from widely scattered localities, with large numbers of historical records but few recent collections. There is a single collection from Broken Hill and only two collections since 1915, the most recent being 1950. Also previously recorded from Bourke, Cobar, Urana, Lake Cargelligo, Balranald, Wanganella and Deniliquin. Recorded more recently from the Hay Plain, south-eastern Riverina, and from near Pooncarie. Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Recorded in a wetland-grassland community comprising *Eragrostis australasicus, Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma* and *Pycnosorus globosus*, on waterlogged grey-brown clay. Also recorded from a *Maireana pyramidata* shrubland.	Moderate
Swainsona colutoides Bladder Senna	-	E	-	Occurs in the south-western corner of NSW, with several populations all located within Tarawi Nature Reserve. Also found in inland parts of southern Western and South Australia (where it is widespread), and in the Northern Territory near Alice Springs. Grows on sandy flats or skeletal hillside soils in mallee woodland. Plants are usually found in large numbers in areas of previous controlled burns and wildfires. Populations in Tarawi NR restricted to an area burned 18 months previously. Associated species include post-fire shrubby regrowth of *Eucalyptus socialis, E. dumosa* and *E. gracilis*, with understorey shrubs of *Myoporum platycarpum* subsp. *platycarpum, Acacia colletioides, Triodia scariosa* subsp. *scariosa, Grevillea huegelii* and *Beyeria opaca*. Bare ground with very little leaf litter constituted the ground layer.	Low
Swainsona murrayana Slender Darling-pea	V	V	3VCi	Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	Moderate

Threatened Flora	Status			Distribution and Habitat Requirements*	Habitat Suitability in Proposal Area
	EPBC Act	TSC Act	RoTAP*		
Swainsona viridis Creeping Darling Pea	-	E	3K	Uncommon in the Broken Hill and Silverton districts in the far north-western plains of NSW. Also occurs in the Flinders Ranges area of SA. Grows in dry, sandy or stony areas on the banks or in the beds of creeks. Found in the Broken Hill area on sandy soils near watercourses. Also collected along a roadside sandplain in sandy-loam soil. Flowering time is from August to November.	Moderate-High

* RoTAP (Briggs and Leigh 1996) Codes	EPBC Act and TSC Act Codes
2 = Geographic Range in Australia less than 100km 3 = Geographic Range in Australia greater than 100km V = Vulnerable – at risk over longer period (20-50 years) E= Endangered – at risk within 10-20 years. R = Rare – uncommon plants with no current threats C = Reserved K = Poorly Known – Inadequate field distribution information i = Less than 100 plants in conservation reserves	E = Endangered E2 = Endangered Population V = Vulnerable * Distribution and habitat requirement information adapted from the Department of Environment and Conservation Threatened Species Website (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/browse_allspecies.aspx)

- Table 3-2: Threatened fauna previously recorded in the locality

Species	Status		Distribution and habitat requirements	Habitat suitability in proposal area
	EPBC Act	TSC Act		
Birds				
Australian Bustard (*Ardeotis australis)*		E1	The Australian Bustard is a highly nomadic omnivore found in mainland Australia. In NSW it occurs in the central west and western regions with most abundance in the north west. Breeding has only been reported in north western NSW near Bourke where it breeds on bare ground on sandy or stony ridges in grassland and shrubland ecotone. Flocks have been seen in tussock to hummock grassland, light shrubland and woodlands, and pastoral and cropping country. It prefers habitat with less than 10% canopy cover and less than 2m high where grasses are dominant. It has irregular movements that responds to rainfall and high abundance of mice and recently burnt areas	Chenopod shrublands and low shrubland habitats on site are suitable for this species.
Bush Stone-curlew (*Burhinus grallarius)*		E1	A nocturnal species, active during moonlit nights. Found in all mainland states of Australia. In south eastern Australia it sparsely distributed in limited numbers along the coast and west of the Great Dividing Range in central NSW on the Western Slopes and Plains and Riverina District. It nests and roosts on the ground near fallen timber and in dry, open grassy woodlands. It prefers habitat with an understorey	Not expected, rare species in the locality and habitat not suitable.

Species	Status		Distribution and habitat requirements	Habitat suitability in proposal area
	EPBC Act	TSC Act		
			littered with timber and branches which it uses for camouflage in association with *Casuarina*, *Eucalyptus* and *Acacia*. Breeding in spring to early summer.	
Rufous Fieldwren (*Calamanthus campestris)*		V	From the eight subspecies known to exist in arid and west coastal southern Australia, the subspecies *isabellinus* has the most records in NSW. The Rufous Fieldwren occurs in the far western NSW centred around Broken Hill, Mutawintji and Fowlers Gap area. Its current distribution is poorly known. It inhabits low, sparse or dense chenopod shrubland and healthland dominated by saltbush, bluebush. It nests on the ground under low shrubs or grass tussocks.	Chenopod shrublands and low shrubland habitats on site are suitable for this species.
Pied Honeyeater (*Certhionyx variegatus)*		V	The Pied Honeyeater is nomadic and follows flowering across central and north and south western NSW. During drought periods it may occasionally occur further east to the Hunter Valley. It inhabits primarily Mulga wattle, mallee and spinifex eucalypt woodlands. It feeds on nectar from emu bush, mistletoes and other various shrubs with fruit, berries, seeds and flowers.	Chenopod shrublands and low shrubland habitats on site are suitable for this species.
White-fronted Chat (*Epthianura albifrons)*		V	A gregarious, insectivorous species, endemic to the southern half of Australia. Mostly found in arid and temperate areas, in damp, grassy open habitats of southern NSW occupying foothills and lowlands. It occurs near waterways in western NSW and is found in saltmarsh vegetation, open grasslands and the borders of wetlands on the coast.	Chenopod shrublands and low shrubland habitats on site are suitable for this species.
Little Eagle (*Hieraaetus morphnoides)*		V	It has a single population that occupies open eucalyptus forest and woodland along the eastern and central regions of NSW. The Little Eagle uses *Casuarina* and *Acacia* woodlands and riparian woodlands in the states interior and towards the south west. It builds large stick nests during winter in living trees of remnant vegetation.	May fly over the site, prey species present however very limited roosting and nesting opportunities.
Hooded Robin (*Melanodryas cucullata)*		V	It is widespread across NSW except in the north west where drier deserts occur and in the wetter coastal areas. It prefers structurally diverse habitats with mature to juvenile *Eucalyptus*, small shrubs and moderately tall grasses in open eucalypt woodland, *Acacia* scrub and mallee near open areas. Low dead stumps, fallen timber and low hanging branches are used as perches for pouncing upon insect prey.	Not expected, no tree/woodland cover.
Scarlet-chested Parrot (*Neophema splendid)*		V	It inhabits semi arid areas scattered across central Australia in mallee and mulga scrubland and open woodlands with spinifex and saltbush groundlayers. The far west of NSW has rare records around Bourke and Broken Hill with more recent records found in the Scotia sanctuary. It nests close to the ground within small mallee *Eucalyptus* and Mulga trees and forages on seeds from spinifex, herbs and *Acacia* species. It drinks from dew and chewing on water storing plants to hydrate when far from water.	Not expected, no tree/woodland cover.
Blue-billed Duck (*Oxyura australis)*		V	Endemic to south eastern and south western Australia where it is widespread across NSW mostly occurring in the Murray-Darling Basin area. The Blue-billed Duck is totally aquatic and congregates and breeds in large,	Not expected, potential habitat absent.

Species	Status		Distribution and habitat requirements	Habitat suitability in proposal area
	EPBC Act	TSC Act		
			deep, open, well vegetated swamps, freshwater dams,wetlands and lakes. It is commonly found west of the Great Dividing Range at Willandra Creek, Lachlan River, Narran lake and Lignum swamps of the Paroo; and is only seen on the coast during drier times or during summer.	
Night Parrot *Pezoporus occidentalis*		E1	The Night Parrot is highly nomadic, restricted to arid and semi arid Australia in sapphire and chenopod floodplains, salt lakes and clay pans. It is considered one of the most elusive and mysterious bird species. It is known to inhabit Spinifex grasslands in stony and sandy areas where large and dense clumps of Spinifex occur. During drought periods it will disappear from suitable habitats.	Not expected, potential habitat absent.
Redthroat (*Pyrrholaemus brunneus)*		V	The Redthroat is a small sedentary bird endemic to southern mainland Australia. It occurs in far western NSW in known populations occurring in the Bulloo Overflow and records around Broken Hill and other south western areas in chenopod shrublands. In Broken Hill it tends to appear in dense vegetation associated with *Acacia* of drainage lines from rocky hills.	Chenopod shrublands and low shrubland habitats on site are suitable for this species.
Australian Painted Snipe (*Rostratula australis)*	V (Mig)	E1	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage treatment plants and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum, (*Muehlenbeckia*) or canegrass or sometimes tea-tree (*Melaleuca*).	Not expected, no significant wetland habitats. Water on site restricted to a very small artificial dam with no aquatic vegetation.
Spotted Harrier (*Circus assimilis)*		V	It occurs throughout mainland Australia, except in dense forest or woodland along the coast. NSW has a single population found across most of the state in open grassy woodland with *Acacia* and mallee remnants, inland riparian woodland and grassland, shrub steppe. It forages in native grassland and agricultural land and preys on banditcoots, bettongs, rodents and reptiles and birds.	Chenopod shrublands and low shrubland habitats on site are suitable for this species for hunting. Very limited opportunity for roosting and nesting
Black-breasted Buzzard (*Hamirostra melanosternon)*		V	Occurs in Central and north and south western NSW in a range of inland habitats associated with timbered watercourses where it breeds. It hunts over grassland and sparsely timbered woddlands.	May fly over the site, prey species present however very limited roosting and nesting opportunities on the site.
Major Mitchell's Cockatoo (*Cacatua leadbeateri)*		V	Is known to occur across most of semi arid and arid Australia. It inhabits a wide range of wooded and treeless inland habitats with proximity to water. It needs hollow trees to breed. It feeds on seeds on the ground from native and exotic melons and saltbush, wattles and cypress pine.	Not expected, no tree/woodland cover.
White-throated Needletail (*Hirundapus caudacutus*)	Mig	-	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Higgins 1999; Simpson & Day 1999). Has been observed roosting in dense foliage	May fly over the site, however not expected to utilise habitat on site.

Species	Status		Distribution and habitat requirements	Habitat suitability in proposal area
	EPBC Act	TSC Act		
			of canopy trees, and may seek refuge in tree hollows in inclement weather (Higgins 1999).	
Rainbow Bee-eater (*Merops ornatus)*	Mig		Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). Usually occurs in open, cleared or lightly-timbered areas, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Woinarski et al. 1988).	Not expected, no tree/woodland cover.
Great Egret (*Ardea alba*)	Mig		Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Not expected, no suitable habitat. Water on site restricted to a very small artificial dam with no aquatic vegetation.
Cattle Egret (*Ardea ibis*)	Mig		Is found in grasslands, woodlands and wetlands particularly in coastal areas. It also uses pastures and croplands, especially where drainage is poor. Is often seen with cattle and other stock.	Not expected, no suitable habitat. Water on site restricted to a very small artificial dam with no aquatic vegetation.
Latham's Snipe (*Gallinago hardwickii*)	Mig		Occurs in permanent and ephemeral wetlands, usually inhabiting open, freshwater wetlands with low, dense vegetation (eg swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977)	Limited potential, not optimum habitat. Water on site restricted to a very small artificial dam with no aquatic vegetation.
Fork-tailed Swift (*Apus pacificus*)	Mig		A migratory species recorded in all regions of Australia. Most records occur east of the Great Dividing Range with some populations recorded west to Bourke. They mostly occur over dry or open habitats, also including riparian woodland, *Melaleuca* swamps, low scrub, heathland and saltmarsh.	May fly over the site, no roosting habitat and is not expected to utilise habitat on the site.
Mammals				
Kultarr (*Antechinomys lanigera*)		E1	Widespread in a variety of sparsely vegetated semi arid and arid landscapes of central and far north western NSW. It occurs near Bouke on the Darling Flood Plain. Prefers habitat with little disturbance in open shrub and mallee woodland and shrubland, *Acacia* woodlands and hummock grasslands with little cover. This nocturnal species takes shelter in hollow logs or tree stumps, and beneath saltbush and spinifex tussocks, also in soil cracks and trapdoor spiders, hopping mice and reptile burrows.	May occur, however habitat is marginal due to a lack of cover and shelter microhabitats in the form of logs or cracking clays.
Stripe-faced Dunnart (*Sminthopsis macroura*)		V	Rare in NSW, occurring in the Central West Slopes and North West Slopes in native dry grassland and low dry shrubland along drainage lines where good quality food and shelter resources are available. It prefers ungrazed habitats with a diverse and healthy understorey. They shelter in soil cracks and in grass tussocks or under rocks and logs. Co-exists with the common Fat-tailed Dunnart.	May occur, however habitat is marginal due to a lack of cover and shelter microhabitats in the form of cracking clays. No recent records in the locality.
Bolam's Mouse		E1	Occurs in the south west corner of NSW with records in Scotia mallee and Tarawi Nature Reserve, Nanya	Chenopod shrublands and low shrubland habitats on

Species	Status		Distribution and habitat requirements	Habitat suitability in proposal area
	EPBC Act	TSC Act		
(*Pseudomys bolami*)			Station and Scotia Sanctuary. This mouse has been trapped in recent surveys conducted to the east of Broken Hill. Inhabits a wide variety of habitats with a preference to chenopod shrubland plains or low mallee woodland with an *Acacia, Dodonaea* and *Eremophila* understorey. They feed on seeds, fruits and blossoms and shelter in burrows during the day.	site are suitable for this species.
Greater Stick-nest Rat (*Leporillus conditor*)	V	E	Once found in semi arid and arid zones of Australia, only one natural population is known on Franklin Island, South Australia. Considered to extinct in NSW. It inhabits perennial shrublands with the presence of succulent plant species.	Not expected, site may be outside of known distributional range, and habitats not optimum.
Long-tailed Hopping-mouse (*Notomys longicaudatus*)	E	E	Considered extinct in all of Australia. Habitats preferences unknown.	Not expected, habitat not suitable.
Little Pied Bat (*Chalinolobus picatus*)		V	It is found roosting in caves, rocky outcrops and tree hollows and forages in dry open forest, woodland, mulga woodlands, chenopod shrublands, mallee and Bimbil Box woodlands and Cypress Pine forest. It is known and predicted to occur in all regions west of the Great Dividing Range in NSW.	Not expected, no tree cover/woodland or roosting habitat.
Greater Long-eared Bat (*Nyctophilus timoriensis* (South-eastern form))	V		It is found throughout inland NSW mainly situated around the Murray Darling Basin with recorded populations in River Red Gum forests. Its distribution also extends from central NSW to the Hunter Valley using a variety of box, ironbark and cypress pine woodlands.	Not expected, no tree cover/woodland.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*		V	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies. Roosts in tree hollows; may also use caves. The Yellow-bellied Sheathtail-Bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats.	Not expected, no tree cover/woodland.
Reptiles				
Tawny Crevice-dragon *Ctenophorus decresii*		E1	It is restricted to rocky gorges and outcrops known in three fragmented locations near Mutawintji National Park and Broken Hill.	Restricted to rock outcrops and gorge habitats not present on the site.
Ringed Brown Snake *Pseudonaja modesta*		E1	The Ringed Brown Snake has limited records in far western NSW in areas such as Tarawi Nature Reserve, south of Broken Hill, Silverton, Tibooburra and Bourke. It inhabits dry areas with rocky outcrops and dry watercourses in a variety of woodlands, shrublands, mallee and grasslands. Takes shelter at night in abandoned animal burrows and ground debris.	May occur, habitat is marginal due to a lack of shelter microhabitats in the form of logs or burrows.
Yellow-tailed Plain Slider *Lerista xanthura*		V	Two populations occur in NSW between Tarawi Nature Reserve and Broken Hill, the other population occurs in the north west corner of the state. Inhabits semi-arid and arid landscapes with grassy alluvial sands and sands dunes, and also dry open woodlands.	Not expected, habitat unsuitable.
Western Blue-tongued Lizard *Tiliqua occipitalis*		V	Records are scattered across central and south western NSW. It is found on plains, swales, ranges and	Not expected, habitat unsuitable.

Species	Status		Distribution and habitat requirements	Habitat suitability in proposal area
	EPBC Act	TSC Act		
			sometimes dunes with vegetated malle shrublands, heaths and hummock grasslands. With preferred habitat having mixed mallee *Triodia* habitats.	

EPBC Act and TSC Act Codes
E = Extinct
E1 = Endangered
E2 = Endangered Population
V = Vulnerable
Mig = Migratory listed species (EPBC Act)

The threatened species assessment was based on the results of the field survey and habitat assessment and a review of the known habitat requirements of the listed species. The assessment concludes that at least two threatened flora species have a high likelihood of occurring, the Koonamore Daisy (*Erodiophyllum elderi*) and the Creeping Darling Pea (*Swainsona viridis*) and eight threatened fauna have at least a moderate to high chance of occurring based on the habitats present. This includes the Little Eagle, Black-breasted Buzzard, Spotted Harrier, Redthroat, Rufous Fieldwren, White-throated Chat, Australian Bustard, and Pied Honeyeater.

Targeted surveys were conducted for these species using the methods described in section 2.2. The remaining threatened species are not expected due to the absence of suitable habitat, or the marginal nature of the habitat as a result of a general lack of important habitat features and microhabitat types

3.2. Field Survey

The extent and quality of native vegetation, flora and fauna species and fauna habitat were recorded from the project study area. General vegetation and habitat data were collected for the surrounding proximal lands in some areas including lands adjacent to the site which would be impacted by the upgrade of the connecting power easement.

3.2.1. Floristic Diversity

The majority of the study area supports remnant vegetation in a relatively natural condition, although some areas exhibit evidence of disturbance in the form of selective vegetation clearance, track formation and minor weed invasion as a result of past land use activities.

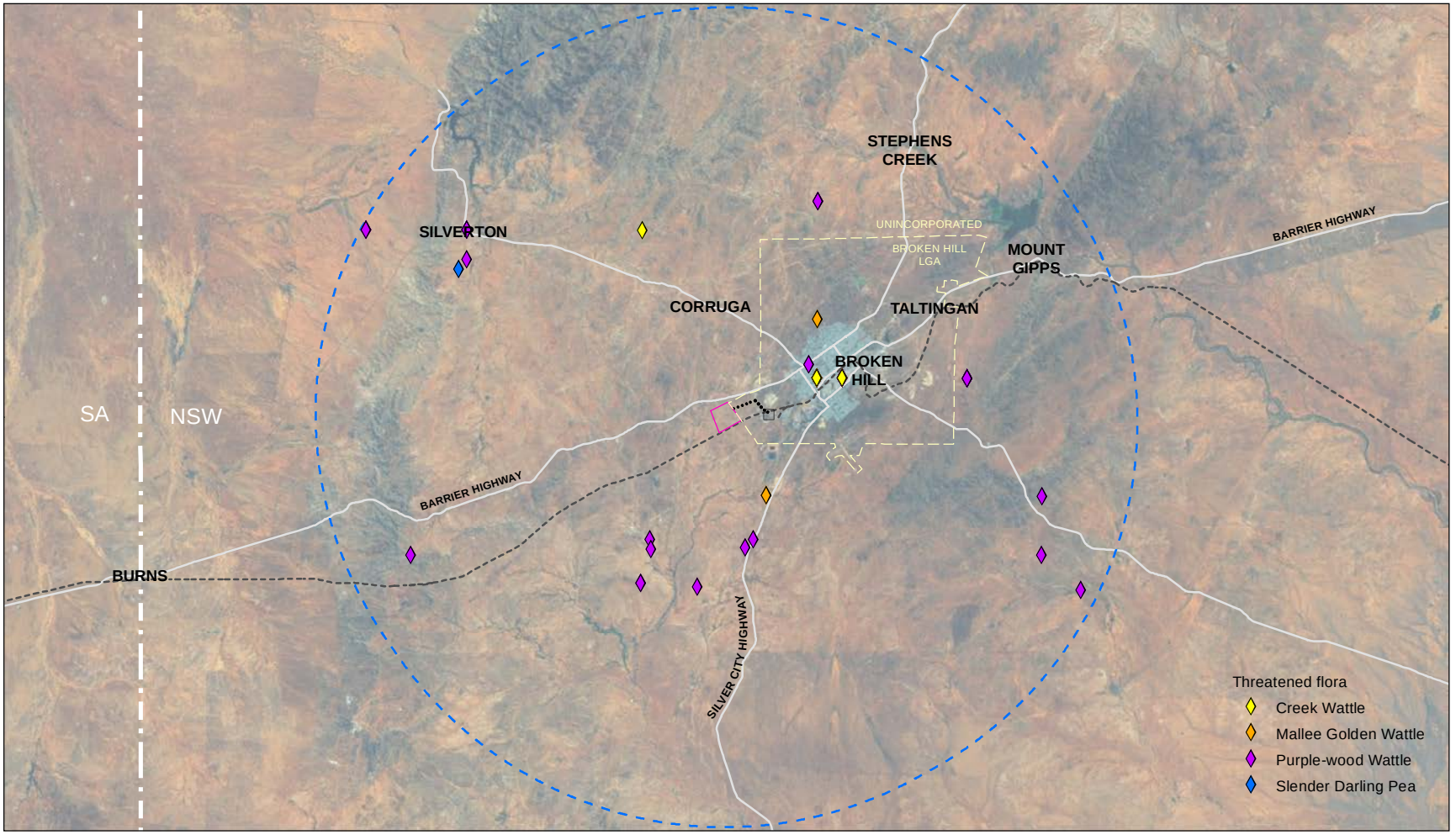

Figure 3-1 Threatened flora within 25km of the proposal

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Spatial Team - Prepared by : JC
Checked by : JL

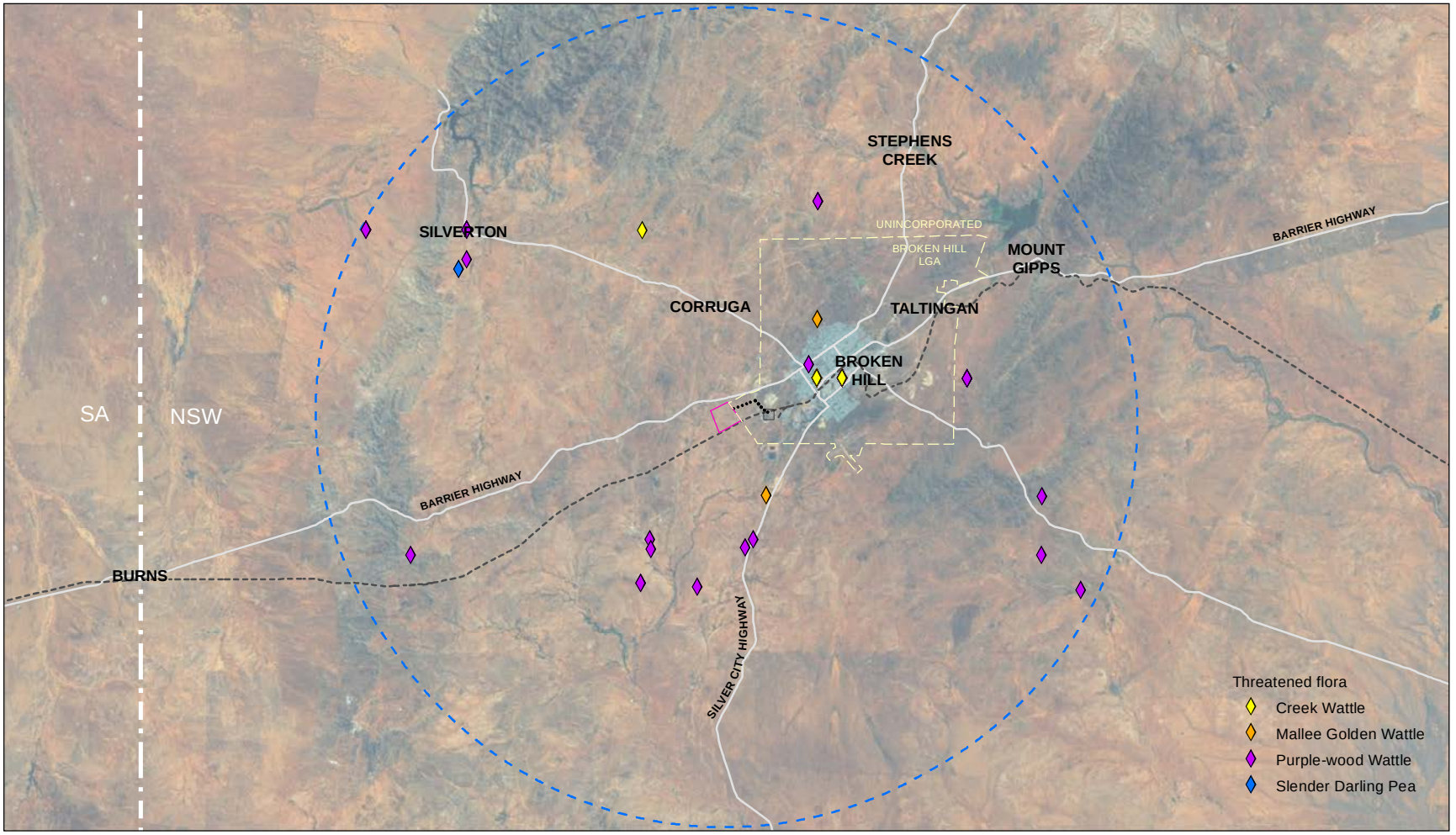

Figure 3-1 Threatened flora within 25km of the proposal

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Spatial Team - Prepared by : JC
Checked by : JL

A total of 129 plant species from 32 families were identified from the survey across the site. This total was composed of two fern species, 110 species of dicotyledons and 17 species of monocotyledons. Of the total species recorded, 19 species of introduced flora were identified, representing approximately 15% of the total species richness. A list of all flora species present within the study area has been included as Appendix B.

3.2.2. Vegetation Communities

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

The study area is within an ecotonal area between two broad vegetation communities as described by Keith (2006) comprising Gibber Chenopod Shrublands and Aeolian Chenopod Shrublands. There are typical characteristics of both of these communities on the site including similar floristic affinities and a mix of rocky substrates and deeper sandy soils. Dominant shrub species include Cassia (*Senna* sp.), Mulga (*Acacia aneura*) and Sandhill Wattle (*Acacia burkittii*). A total of six map units have been mapped and described as shown in Figure 3-1, comprising four main vegetation communities, and two modified areas. Vegetation communities have been classed according to biometric vegetation types and the NSW Vegetation Classification and Assessment (VCA) (Benson 2006), comprising:

- Map Unit 1: Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (VCA 153)
- Map Unit 2: Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone (VCA 136)
- Map Unit 3: Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland of semi-arid and arid sandplains and dunes (VCA 143)
- Map Unit 4: Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions (VCA 123)

There are also two areas which have been modified by earthworks (Map Unit 6) comprising a disturbed example of Map Unit 1, and the residential area (Map Unit 7) in the centre of the proposed project site. These areas have been mapped in Figure 3-1 as the following map units:

- Map Unit 5: Disturbed Chenopod Low Open Shrubland
- Map Unit 6: Cleared Residential

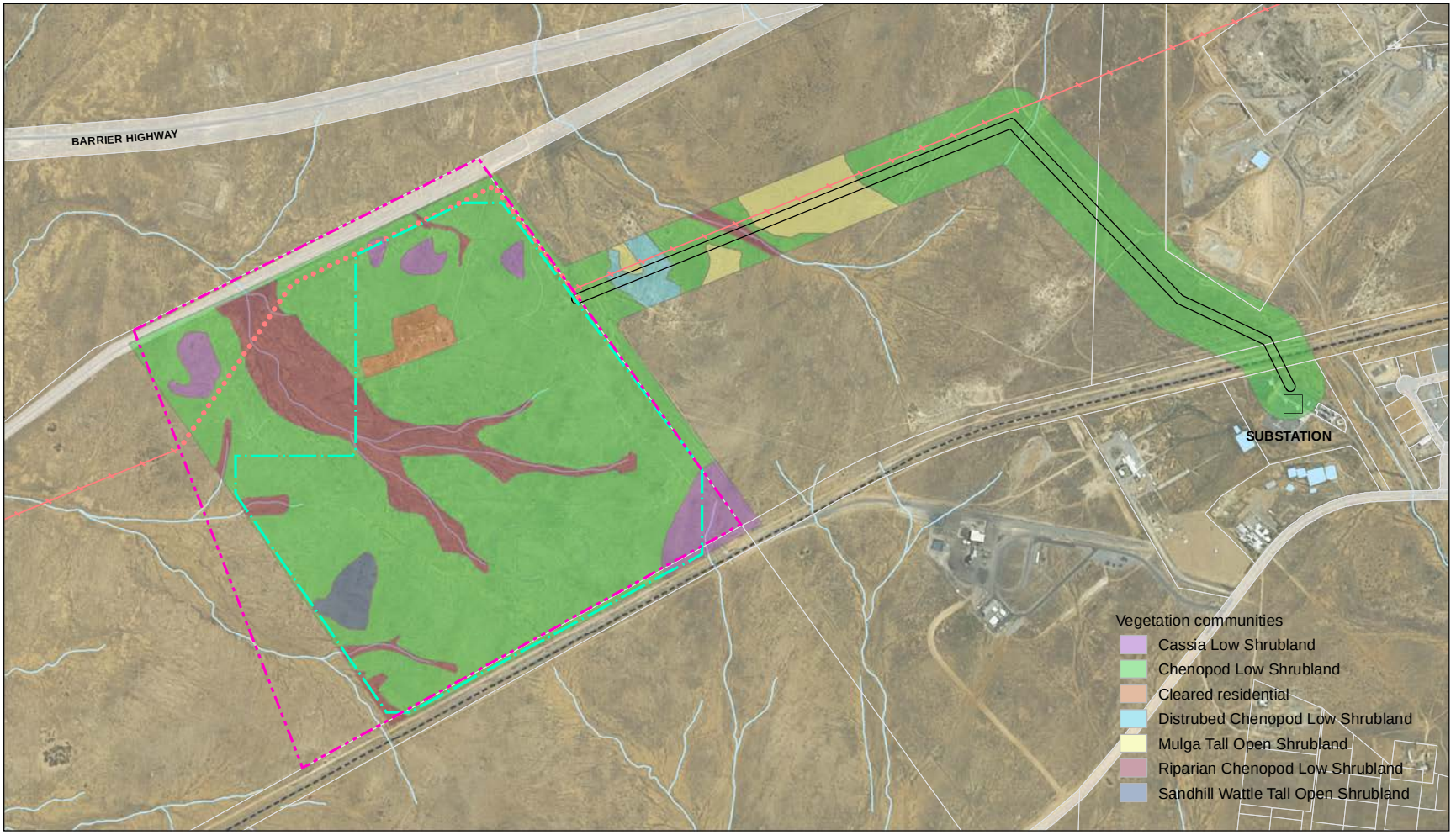

Figure 3-3 Vegetation communities

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Spatial Team - Prepared by : JC
Checked by : JL

Map Unit 1: Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones

This community occurs across the majority of the study area and is widely disturbed in surrounding areas. This community is closely related to all other map units sharing many of the same species. It has an open low shrubland structure and is dominated by chenopod shrub species including Black Bluebush (*Maireana pyramidata*) and Pearl Bluebush (*Maireana sedifolia*) up to 1.5 m high. Other common shrub species include Silky Bluebush (*Maireana villosa*), Bladder Saltbush (*Atriplex vesicaria*) and Angular Saltbush (*Atriplex angulata*). There is a low abundance of taller shrub species 2-4 m high such as Prickly Wattle (*Acacia victoriae*), Dead Finish (*Acacia tetragonophylla*) and Narrow-leaf Emu-bush (*Eremophila sturtii*). Several Cassia (*Senna* spp.) species are also dispersed throughout this community.

The groundlayer is highly diverse supporting a mix of herbs, grasses and small shrubs including Corrugated Sida (*Sida corrugata*), Sturt's Desert Pea (*Swainsona formosa*), Broken Hill Pea (*Swainsona fissimontana*), Variable Daisy (*Brachyscome ciliaris* var. *lanuginosa*), Speargrass (*Austrostipa scabra*), Red-flowered Lotus (*Lotus cruentus*), Bottle Washers (*Enneapogon avenaceus*) and Ruby Saltbush (*Enchylaena tomentosa*).

There are some weed species scattered throughout this community particularly along the edges of trails and in other disturbed areas (i.e. Map Unit 6 and 7). Dominant introduced species include Onion Weed (*Asphodelus fistulosus*), Ward's Weed (*Carrichtera annua*), Common Ice Plant (*Mesembryanthemum crystallinum*) and Saffron Thistle (*Carthamus lanatus*).

Keith Class: Aeolian Chenopod Shrublands
Equivalent Biometric Vegetation Type: Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (Benson 153)

Map Unit 2: Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone

This community occurs along drainage lines in the study area and is closely related to Map Unit 1 sharing many of the same species, however it has a denser ground cover with less shrub cover, and numerous areas of bare ground caused by erosion during storm events. It has an open low shrubland structure and is dominated by chenopod shrub species including Bladder Saltbush (*Atriplex vesicaria*), Mallee Saltbush (*Atriplex stipitata*) and Angular Saltbush (*Atriplex angulata*) to 1 m high. Other common shrub species include Black Bluebush (*Maireana pyramidata*), Pearl Bluebush (*Maireana sedifolia*), Western Boobialla (*Myoporum montanum*), Prickly Wattle (*Acacia victoriae*) and Cassia (*Senna* spp.).

The ground layer is relatively dense in areas of this community due to the higher moisture availability. Dominant groundcover species include: grass species such as Bottle Washers (*Enneapogon avenaceus*), Leafy Nineawn (*Enneapogon polyphyllus*), Windmill Grass (*Chloris truncata*), Scent Grass (*Cymbopogon ambiguus*) and Queensland Bluegrass (*Dichanthium sericeum* subsp. *sericeum*); small shrubs including Low Hibiscus (*Hibiscus brachysiphonius*), Silky Bluebush (*Maireana villosa*) and Twiggy Sida (*Sida intricata*); herb species include Variable Daisy (*Brachyscome ciliaris* var. *lanuginosa*), Fuzzweed (*Vittadinia eremaea*), Sarcozona (*Sarcozona praecox*) and Flat Billy-buttons (*Leiocarpa brevicompta*). Scrambling species were also relatively common along drainage lines including Bindweeds (*Convolvulus* sp.) and Climbing Twinleaf (*Zygophyllum eremaeum*). There were some small pools present at the time of the survey along the drainage lines which supported semi-aquatic species such as Common Nardoo (*Marsilea drummondii*) and Lesser Joyweed (*Alternanthera denticulata*).

There are some weed species scattered throughout this community particularly at the northern

end of the main drainage line. Dominant introduced species include Trailing Verbena (*Verbena supina*), Square-stemmed Vetch (*Vicia monantha*), Pepper Tree (*Schinus areira*) and Maltese Cockspur (*Centaurea melitensis*).

Keith Class: Aeolian Chenopod Shrublands: Gibber Chenopod Shrublands

Equivalent Biometric Vegetation Type: Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone (Benson 136)

Map Unit 3: Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland of semi-arid and arid sandplains and dunes

This community tends to occur on more elevated areas of the study area. It is distinguished from other vegetation communities by the dominance of several Cassia species (*Senna* sp.), however it shares many of the same species as the surrounding Chenopod shrubland. It has a low shrubland structure 1-1.5 m high and is dominated by various Cassia species including Silver Cassia (*Senna form taxon 'artemisioides'*), *Senna form taxon 'coriacea', Senna form taxon 'filifolia'* and *Senna phyllodinea.* Other common shrub species include Prickly Wattle (*Acacia victoriae*), Dead Finish (*Acacia tetragonophylla*) and Black Bluebush (*Maireana pyramidata*).

The ground layer is dense to open in areas of this community and includes a mix of grasses, herbs and sub-shrubs. Dominant groundcover species include Bottle Washers (*Enneapogon avenaceus*), Silky Bluebush (*Maireana villosa*), Fuzzweed (*Vittadinia eremaea*), Broken Hill Pea (*Swainsona fissimontana*) and Veined Peppercress (*Lepidium phlebopetalum*).

There are some weed species scattered throughout this community particularly along the edges of trails and in other disturbed areas (i.e. Map Unit 6). Dominant introduced species include Onion Weed (*Asphodelus fistulosus*) and Ward's Weed (*Carrichtera annua*).

Keith Class: Aeolian Chenopod Shrublands: Sand Plain Mulga Shrublands

Equivalent Biometric Vegetation Type: Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland of semi-arid and arid sandplains and dunes (Benson 143)

Map Unit 4: Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions

This community occurs in the vicinity of the proposed cable alignment to the east of the proposed project site, occurring on elevated lands and extending down onto the flatter areas. It is distinguished from other vegetation communities by the tall open shrubland structure to 4 m high dominated by Mulga (*Acacia aneura*), however it shares many of the same species as the surrounding Chenopod shrublands. Other shrub species present in this community which may be dominant in areas include Sandhill Wattle (*Acacia burkittii*), Prickly Wattle (*Acacia victoriae*), Silky Blusbush (*Maireana villosa*), Cannonball Burr (*Dissocarpus paradoxus*), Narrow-leaved Hopbush (*Dodonaea viscosa subsp. angustissima*), *Senna phyllodinea*, *Sida petrophila,* Thargomindah Nightshade (*Solanum sturtianum*) and *Sclerolaena eriacantha.*

The ground layer is dense to open and includes a mix of grasses, herbs and sub-shrubs. Dominant groundcover species include grasses such as Bottle Washers (*Enneapogon avenaceus*), Leafy

Nineawn (*Enneapogon polyphyllus*), Mallee Lovegrass (*Eragrostis deilsii*) and Speargrass (*Austrostipa scabra*). Other dominant groundcover species include Ruby Saltbush (*Enchylaena tomentosa*), *Sclerolaena eriacantha*, Broken Hill Pea (*Swainsona fissimontana*) and *Glycine rubiginosa*.

There are some weed species scattered throughout this community particularly along the edges of trails and in other disturbed areas (i.e. Map Unit 6). Dominant introduced species include Onion Weed (*Asphodelus fistulosus*) and Ward's Weed (*Carrichtera annua*).

Keith Class: Aeolian Chenopod Shrublands: Stony Desert Mulga Shrublands
Equivalent Biometric Vegetation Type: Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions (Benson 123)

Map Unit 5: Disturbed Chenopod Low Open Shrubland

This map unit occurs to the east of the proposed project site, in the vicinity of the proposed alignment of the transmission line corridor. This map unit is a disturbed example of Map Unit 1 having a similar species composition and vegetation structure. This community differs in that earthworks have been implemented in this area (refer to above picture) and therefore supports a lower cover of shrub species and more groundcovers. There is also a higher proportion of weed species in this area

Keith Class: Aeolian Chenopod Shrublands: Aeolian Chenopod Shrublands

Equivalent Biometric Vegetation Type: Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (Benson 153)

3.2.3. Threatened Ecological Communities

No threatened ecological communities listed under TSC Act or EPBC Act were identified on the site or immediate surrounds. Only one EEC was identified as potentially occurring in the study area comprising *Acacia loderi* Shrubland, however the field survey confirmed the absence of this community on the site. Several other species of Wattle (*Acacia*) were recorded however targeted searches did not identify the threatened species Nealie (*Acacia loderi).*

3.2.4. Vegetation condition

The vegetation condition was determined through comparisons of vegetation data collected in the study area with recognised benchmarks (refer to Table 3-3). As no formal biobanking plots were undertaken, data collected in the study area has been interpreted and categorised against benchmarks for each vegetation community. Given the homogenous nature of the vegetation communities/zones mapped in the study area, a single biometric condition score was attributed to each vegetation community/zone. The results of this assessment indicate that much of the vegetation on site is in a near natural state, with some reduction in condition associated with clearing for tracks and trials, erosion and natural pant dieback.

- Table 3-3: Biometric condition of vegetation in the study area extrapolated from field data

Category	Weighting (%)	MU1:	MU2	MU3	MU4	MU5
Native Plant Species Richness	25	Within benchmark	Within benchmark	Within benchmark	Within benchmark	Within benchmark
Native Over-storey Cover	10	50% to <100% or >100% to 150% of benchmark	50% to <100% or >100% to 150% of benchmark	50% to <100% or >100% to 150% of benchmark	50% to <100% or >100% to 150% of benchmark	0% to 10% or >200% of benchmark
Native Mid-storey Cover	10	50% to <100% or >100% to 150% of benchmark	50% to <100% or >100% to 150% of benchmark	50% to <100% or >100% to 150% of benchmark	50% to <100% or >100% to 150% of benchmark	0% to 10% or >200% of benchmark
Native Ground Cover-grasses	2.5	50% to <100% or >100% to 150% of benchmark	Within benchmark	Within benchmark	50% to <100% or >100% to 150% of benchmark	>10% to <50% or >150% to 200% of benchmark
Native Ground Cover-shrubs	2.5	Within benchmark	Within benchmark	Within benchmark	Within benchmark	0% to 10% or >200% of

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Category	Weighting (%)	MU1:	MU2	MU3	MU4	MU5
						benchmark
Native Ground Cover-other	2.5	Within benchmark	Within benchmark	Within benchmark	Within benchmark	>10% to <50% or >150% to 200% of benchmark
Exotic Species	5	0-5%	0-5%	0-5%	0-5%	>5–33%
Number of Trees with Hollows	20	Within benchmark	Within benchmark	Within benchmark	Within benchmark	Within benchmark
Overstorey regeneration	12.5	50% to 100% of overstorey species regenerating	50% to 100% of overstorey species regenerating	50% to 100% of overstorey species regenerating	50% to 100% of overstorey species regenerating	0% of overstorey species regenerating
Total Length of Fallen Logs (m)	10	Within benchmark	Within benchmark	Within benchmark	Within benchmark	Within benchmark
Total Score	100	88.4	89.2	89.2	88.4	59.9

3.2.5. Threatened Flora

No threatened flora species were recorded from the targeted searches across the project site. As discussed previously two threatened flora species were identified from the initial habitat assessment as having a high likelihood of occurring, the Koonamore Daisy (*Erodiophyllum elderi*) and the Creeping Darling Pea (*Swainsona viridis*). Both species were targeted from comprehensive surveys across the entire proposed project area including the transmission line corridor and were found to be absent. Further information on the habitat types are discussed below in Table 3-3.

Both species flower during the spring and early summer period coinciding with the timing of the targeted surveys (7-10 December 2010). In addition, these surveys were conducted following high rainfall in November 2010 (65.2 mm) more than three times the historical average for November in Broken Hill. Additionally there was a further 50 mm of rainfall in December around the time of the survey. These conditions would suggest that the survey was conducted at the optimum time for detection of both threatened species and provides some certainty around their derived absence from the site.

- Table 3-4: Threatened flora species with suitable habitat types present in the study area

Threatened Flora	Status			Potential to occur in the study area
	EPBC Act	TSC Act	RoTAP	
Erodiophyllum elderi Koonamore Daisy	-	E	-	There is a record of this species from 1921 approximately 61 km southwest of the study area. The flat open areas of sandy calcareous soils in the proposal area provide potentially suitable habitat for the Koonamore Daisy. Associated vegetation includes *Acacia aneura* shrubland with *A. burkittii* and *Dissocarpus paradoxus*,

Threatened Flora	Status			Potential to occur in the study area
	EPBC Act	TSC Act	RoTAP	
				all of which are present in the study area, in particular within the Mulga Tall Open Shrubland and Sandhill Wattle Tall Open Shrubland (Map Units 4 and 5). Koonamore Daisy flowers during spring and early summer, so the survey period was optimum (7-10 December 2010). Further, given the above average rainfall during spring/summer 2010 in Broken Hill, flowering plants and live material of this species is likely to have been present including seed heads (achenes) which would have been adequate to positively identify this species.
Swainsona viridis Creeping Darling Pea	-	E	3K	Uncommon in the Broken Hill and Silverton districts in the far north-western plains of NSW. There are no historical records of this species on the Thackringa or Broken Hill 1:100,000 map sheets from the OEH Atlas of NSW wildlife (OEH 2010). Creeping Darling Pea grows in dry, sandy or stony areas on the banks or in the beds of creeks, which describe the riparian areas of the proposal area (Map Unit 2). Creeping Darling Pea flowers in spring early summer between August and November, so the survey period was optimum (7-10 December 2010). Further, given the above average rainfall during spring/summer 2010 in Broken Hill, flowering plants and live material of this species is likely to have been present including seed heads (achenes) which would have been adequate to positively identify this species.

3.2.6. Fauna Habitat

The dominant fauna habitat on the site is low open chenopod shrubland which covers all areas of the project site and transmission line corridor. The density and height of shrubs varies probably in response the localised topography, and degree of water retention or run-off. Tussock grasses are also common and vary in height and cover. Mulga is very sparse and restricted to several small patches and dead standing trees. Due to the lack of tree cover and sparseness of the shrub cover there is very limited shelter or cover for birds, small mammals and reptiles. Logs and cracking clay are virtually absent from the site and while rocks are scattered across the site, these are typically small or embedded in the soil and provide very limited cover for reptiles. The exception is a low rocky hill adjacent to the transmission line corridor, although outside of the works area, where larger boulders and crevices occur. The Gecko (*Gehyra variegata)* was common where rocks were present.

There is a central drainage line which exhibits a high cover of bare ground as a result of water erosion, but also contains areas of tall shrubland and mulga and provides cover and nesting opportunities for small birds. A single farm dam is located on the drainage line at the northern boundary and comprises shallow water with grassed edges. This habitat is suited to some water dependent birds, such as the Black-fronted Dotterel (*Elseyornis melanops)* and Red-kneed Dotterel (*Erythrogonys cinctus)*.

A description of the habitat types on the site is provided in Table 3-5 and is derived from multiple habitat assessment points spread across the property, the locations of which are illustrated on Figure 3-4.

- Table 3-5: Descriptions of the fauna habitats on the study area

Site	Cover		Notes	Photo
H01	Tussock grasses	8%	Low open shrubland. Limited cover and shelter for small birds provided by saltbush shrubs. Shallow soils and bare ground scattered throughout. No cover for reptiles, mammals or frogs.	
	Chenopods	80%		
	Mulga	2%		
	Bare ground	10%		
	Cracking clay	0%		
	Rocks / logs	0%		
H02	Tussock grasses	20%	Low open shrubland. Dominated by taller shrubs to 2 m with occasional Acacia 1-2m. Patchy landscape, dense groundcovers in patches with grasses and low shrubs. Sheltering opportunities for mammals and reptiles poorly represented.	
	Chenopods	55%		
	Mulga	5%		
	Bare ground	15%		
	Cracking clay	0%		
	Rocks / Logs	5%		

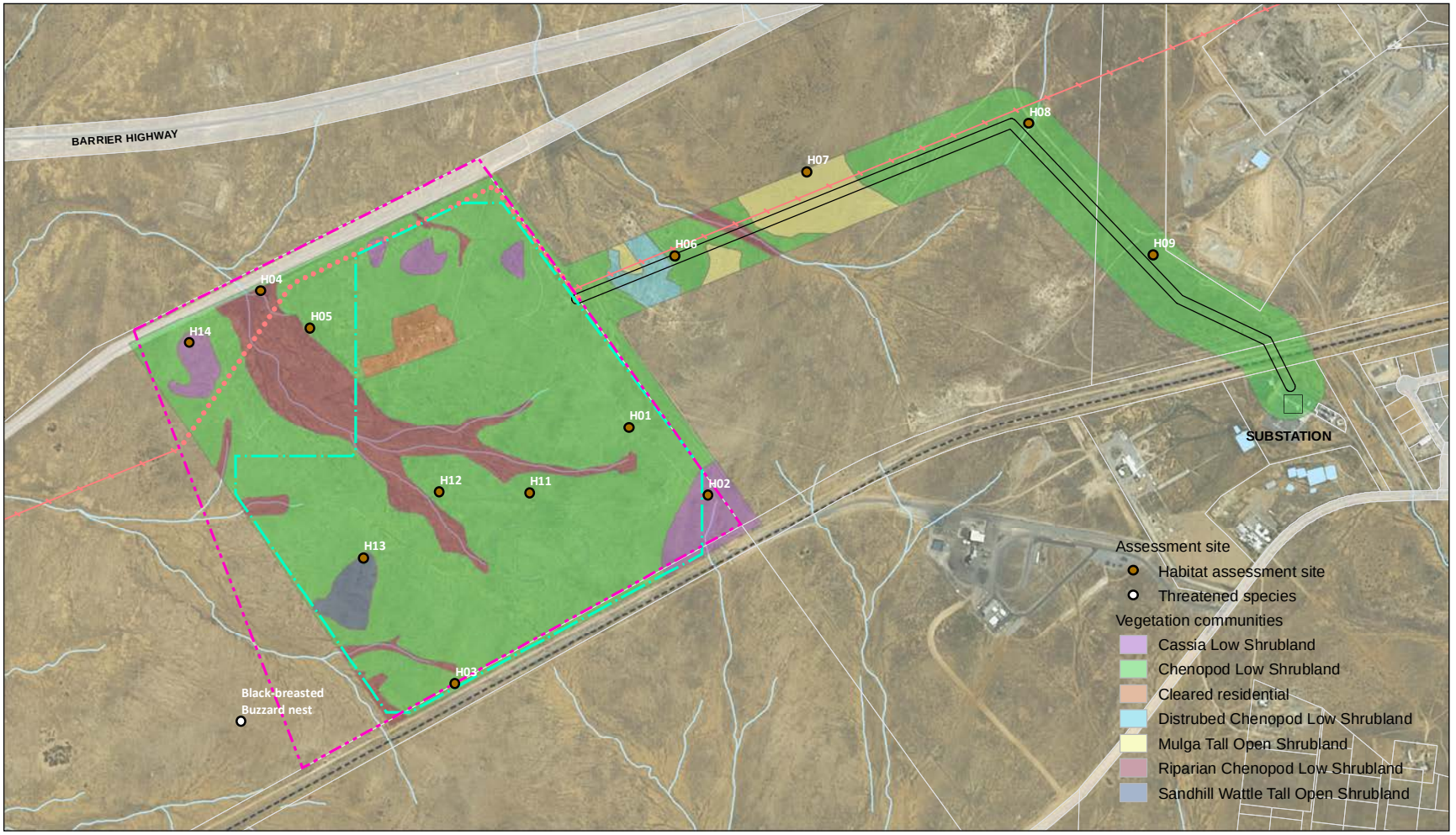

Figure 3-4 Habitat assessment sites

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Spatial Team - Prepared by : JC
Checked by : JL

Site	Cover		Notes	Photo
H03	Tussock grasses	70%	Low open grassland/shrubland. Scattered low density of small rocks. Very limited cover for small birds. No cover for reptiles or mammals.	
	Chenopods	10%		
	Mulga	0%		
	Bare ground	15%		
	Cracking Clay	0%		
	Rocks / Logs	5%		
H04	Tussock grasses	55%	Shallow dam on drainage depression with persistent water. Grassy edges, low grasses and shrubs. Dense shrubs to 1 m thick providing cover for small birds.	
	Chenopods	35%		
	Mulga	5%		
	Bare ground	5%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H05	Tussock grasses	10%	Chenopod shrubland/claypan. Many low shrubs <20cm and sparse taller shrubs up to 70cm. Gravel, lcay substrate. Very small rocks present on surface but not suitable as cover.	
	Chenopods	60%		
	Mulga	0%		
	Bare ground	30%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H06	Tussock grasses	40%	Chenopod shrubland/claypan, density of low groundcovers to 20cm in height, low shrubs to 1.5 m and occasional Mulga providing cover for small birds.	
	Chenopods	35%		
	Mulga	5%		
	Bare ground	20%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H07	Tussock grasses	15%	Acacia woodland comprising tall Mulga to 3-4 m with smaller areas of lower immature tree cover. Varying densities of grassy groundcover and low density of shrubs. Acacias provide cover and breeding opportunities for small birds and cover for reptiles via occasional logs. There is a low rocky hill, with boulders and crevices providing habitat for reptiles.	
	Chenopods	30%		
	Mulga	40%		
	Bare ground	10%		
	Cracking Clay	0%		
	Rocks / Logs	5%		

Site	Cover		Notes	Photo
H08	Tussock grasses	20%	Low open shrubland on clay dominated by low shrubs <1 m and large areas of bare ground. Dense groundcover suitable for small birds and reptiles. Wet areas along shallow drainage line and depressions in tracks. No tree cover.	
	Chenopods	60%		
	Mulga	0%		
	Bare ground	20%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H09	Tussock grasses	70%	Low open shrubland on clay. Bare ground mostly in low-lying areas evident of water erosion. Grass cover is absent in these areas and grasses are more common on slightly higher elevated land. Shrubs dominate low-lying wetter areas.	
	Chenopods	25%		
	Mulga	0%		
	Bare ground	5%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H10	Tussock grasses	40%	Low open shrubland with scattered mulga. Patches of bare ground mostly around shallow depressions and drainage areas. Taller grasses up to 0.5 m.	
	Chenopods	50%		
	Mulga	2%		
	Bare ground	8%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H11	Tussock grasses	60%	Grassland / chenopod shrubland. Dominated by tussock grasses and low shrubs. Slightly higher elevated land, low density of dead mulga. No cover for birds, reptiles or small mammals.	
	Chenopods	25%		
	Mulga	0%		
	Bare ground	15%		
	Cracking Clay	0%		
	Rocks / Logs	0%		
H12	Tussock grasses	60%	Grassland / chenopod shrubland. Dominated by tussock grasses and low shrubs. Slightly higher elevated land, low density of dead mulga. No cover for birds, reptiles or small mammals.	
	Chenopods	25%		
	Mulga	0%		
	Bare ground	15%		
	Cracking Clay	0%		
	Rocks / Logs	0%		

Site	Cover		Notes	Photo
H13	Tussock grasses	30%	Low Mulga scrubland on a low sandy hill. Low wattles to 2.5 m in height. Sandy substrate spread over a low hill with shrubs to 2 m. Scattered small logs and dead Acacia. This habitat is preferred by reptiles and several smaller skinks noted, mainly Ctenotus spp. Moderate density of logs.	
	Chenopods	20%		
	Mulga	20%		
	Bare ground	20%		
	Cracking Clay	0%		
	Rocks / Logs	10%		
H14	Tussock grasses	30%	Grassy shrubland with tall shrubs to 2m and high density of bare ground.	
	Chenopods	20%		
	Mulga	0%		
	Bare ground	50%		
	Cracking Clay	0%		
	Rocks / Logs	0%		

3.2.7. Fauna Species

A total of 37 fauna species were confirmed on the site and surrounds from the field survey comprising 25 bird species, 7 mammal species and 5 reptile species. No amphibians were identified. The diversity of fauna is considered low and reflects the small area of the site, the low diversity of habitats, in particular a lack of aquatic habitat, tree cover, logs and rocks providing shelter for cover dependent species.

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

Similarly reptiles are very scarce across most areas as a result of the lack of sheltering microhabitats, with the exception of two small areas, one an exposed low hill near H07 which comprises large boulders and rock crevices, in which several geckos (*Gehyra variagata*) were recorded sheltering under rocks and a second location at H13, which is a low sandy hill with cover

or mulga including dead trees and logs. This is the only location where the striped skink (*Ctenotus robustus*) and shrubland Morethia skink (*Morethia obscura)* were found.

The low faunal diversity recorded is considered typical of the fauna diversity known from the Broken Hill Complex Bioregion and associated chenopod shrubland habitats (ANRA 2002) and reflects the lack of habitat complexity and diversity.

3.2.8. Threatened and migratory fauna

One threatened fauna species was tentatively identified, the Black-breasted Buzzard (*Hamirostra melanosternon)* listed as vulnerable under the TSC Act. A large raptor was observed to be nesting on an adjacent property to the west of the project site (Figure 3-4 and Plate 1). The bird is considered to be either a Black-breasted Buzzard for Wedge-tailed Eagle, and as precautionary measure has assumed to be the threatened Black-breasted Buzzard. The nest is outside of the zone of influence associated with clearing for the site and is not considered to be directly under threat. The project will remove a portion of the foraging range for this breding pair and habitat for prey species, in particular rabbits. Further discussion on the expected impacts is provided in Section 4. Regardless of the species, steps are to be taken to avoid and minimise disturbance to the nest during construction and these are outlined in Section 5 of the report.

Plate 1. Large raptor nest

No other threatened or migratory fauna species were positively identified on the site, however the habitat is considered suitable for several additional threatened species listed under the TSC Act as discussed in Section 4.

4. Impact Assessment

4.1. Summary of Conservation Values

The majority of the study area supports remnant vegetation in a near natural condition, with the exception of a small number of introduced flora and fauna species and minor selective clearing and impacts from horses, feral goats and rabbits. Minor disturbances are evident and associated with previous and current land-uses, including the development of vehicle tracks and trials, selective vegetation clearing for fencing, livestock grazing, a power easement and the adjacent rail infrastructure. Weeds are uncommon, and mostly restricted to along the edges of tracks and cleared land, in drainage areas and adjacent to existing railway infrastructure on the southern boundary. Weeds are more common along the existing and proposed transmission line corridor to the east where there is a greater degree of disturbance associated with excavation of soil and recreational motorbike use.

The assessment has also identified several areas of lower ecological value, comprising cleared land around the existing houses and sheds and land currently used for access where there is a distinct lack of vegetation including groundcover vegetation. Soil erosion is extensive throughout in particular the central drainage area and appears to be a natural phenomenon associated with the shallow, sandy nature of the topsoil, and low permeability due to high clay content causing wind and water erosion. Large areas of the site, particularly around the drainage lines comprise bare ground. Dieback of small trees and shrubs is evident throughout and may be due to previous drought.

4.1.1. Threatened species

Potential state and nationally listed species identified from the background reviews were assessed to identify their likelihood of occurrence based on the results of the field survey and the known habitat requirements of the species. The likelihood of occurrence was classified according to the criteria described in Table 4-1.

- Table 4-1 Likelihood of occurrence includes one or more of the following criteria

Likelihood of occurrence	Criteria
Unlikely	▪ Species highly restricted to certain geographical areas not within the proposal impact area ▪ Specific habitat requirements were not present in the proposal impact area.
Low	Species not recorded during field surveys and fit one or more of the following criteria: ▪ Have not been recorded previously in the proposal impact area/surrounds and for which the proposal impact area would be beyond the current distribution range. ▪ Use specific habitats or resources not present in the proposal impact area. ▪ A non-cryptic perennial flora species that was specifically targeted by surveys and not recorded.
Medium	Species not recorded during the field surveys that fit one or more of the following criteria: ▪ Have infrequently been recorded previously in the proposal impact area/surrounds. ▪ Use specific habitats or resources present in the proposal impact area but in a poor or modified condition. ▪ Unlikely to maintain sedentary populations, however may seasonally use resources within the proposal impact area opportunistically or during migration. ▪ Cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
High	Species recorded during the field surveys or species not recorded that fit one or more of the following criteria: ▪ Have frequently been recorded previously in the proposal impact area/surrounds. ▪ Use habitat types or resources that were present in the proposal impact area that are abundance and/or in good condition within the proposal impact area. ▪ Known or likely to maintain resident populations surrounding the proposal impact area. ▪ Known or likely to visit the site during regular seasonal movements or migration.

As discussed previously two threatened flora species were identified from the initial habitat assessment as having a high likelihood of occurring, the Koonamore Daisy (*Erodiophyllum elderi*) and the Creeping Darling Pea (*Swainsona viridis*). Both species were targeted from comprehensive surveys and found to be absent on the site.

As both species flower during the spring and early summer and the conditions during the survey were optimum there is a high degree of confidence in assessing these species as having a low likelihood of occurring. Similarly, the remaining threatened flora species identified as having a moderate chance of occurring, including the Purple Wood Wattle (*Acacia carneorum*) were not identified from the field survey and are considered to have a low likelihood of occurring.

The following species were confirmed on the site or identified as having a moderate to high likelihood of occurring despite not being identified and are therefore subject to further assessment of significance with regard to potential impacts. The potential subject species are all listed under the TSC Act and no nationally listed species (EPBC Act) are expected to occur.

- Table 4-2 Summary of ecological values recorded on the site

Threatened Species/Communities/Habitats	Status	Status on site
Acacia loderi Shrublands	EEC (TSC Act)	Absent
Koonamore Daisy (*Erodiophyllum elderi)*	Endangered (TSC Act)	Absent
Creeping Darling Pea (*Swainsona viridis*)	Endangered (TSC Act)	Absent
Purple Wood Wattle (*Acacia carneorum*)	Vulnerable (TSC Act and EPBC Act)	Absent
Black-breasted Buzzard (*Hamirostra melanosternon*)	Vulnerable (TSC Act)	Nesting pair tentatively identified to the west of the site
Redthroat (*Pyrrholaemus brunneus*)	Vulnerable (TSC Act)	Not identified, although habitat is suitable
Rufous Fieldwren	Vulnerable (TSC Act)	Not identified, although habitat is suitable
Pied Honeyeater	Vulnerable (TSC Act)	Not identified, although habitat is suitable
Australian Bustard	Endangered (TSC Act)	Not identified, although habitat is suitable
Spotted Harrier	Vulnerable (TSC Act)	Not identified, although habitat is suitable
White-fronted Chat	Vulnerable (TSC Act)	Not identified, although habitat is suitable
Bolams Mouse	Endangered (TSC Act)	Not identified, although habitat is suitable
Habitat for threatened reptile species	Regionally significant	No

4.1.2. Threatened communities

None of the vegetation types identified on the site are listed as endangered ecological communities under the TSC Act or EPBC Act. However, several of the vegetation communities in the study area have been identified as having a near threatened threat category in the VCA (Benson 2006). The vegetation communities in the study area along with threat categories, reserve status and threatening processes as identified in the VCA (Benson 2006) are provided in Table 4-3.

- Table 4-3 Vegetation communities in the study area, area extents and identified threats (Benson 2006)

Map Unit No.	Biometric vegetation type (VCA ID)	Area on site (ha)	Current extant (ha)	Pre-European extent (ha)	Reservation status	Cleared (DECC 2009b)	Threat Category
1	Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (VCA 153)	183	1.2 million	2.2 million	Inadequate	15%	Near threatened

Map Unit No.	Biometric vegetation type (VCA ID)	Area on site (ha)	Current extant (ha)	Pre-European extent (ha)	Reservation status	Cleared (DECC 2009b)	Threat Category
2	Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone (VCA 136)	26	4000	5000	Inadequate	5%	Least concern
3	Narrow-leaved Hopbush - Scrub Turpentine - Senna shrubland of semi-arid and arid sandplains and dunes (VCA 143)	8	250,000	100,000	Adequate	0%	Least concern
4	Mulga - Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions (VCA 123)	12	500,000	600,000	Inadequate	5%	Near threatened
5	Disturbed - Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (VCA 153)	3	1.2 million	2.2 million	Inadequate	15%	Near threatened
6	n/a	3	n/a	n/a	n/a	n/a	n/a

4.2. Potential Ecological Impacts

The majority of the site is covered with naturally occurring chenopod shrubland and includes potential habitat for a small number of threatened fauna species as discussed above. A footprint of approximately 149.3 hectares of land would be required for development of the project.

To accommodate construction of the project larger shrubs and trees would need to be removed across most of this area for the placement of infrastructure including solar panels, maintenance tracks and building envelopes. While much of the low groundcover vegetation does not need to be cleared, the survivability of the remaining vegetation is likely to be compromised in the long-term by significant altering of the local micro-climatic conditions, in particular the introduction of permanent shade and altered surface run-off conditions associated with the presence of the solar panels. As a result it is expected that the current vegetation assemblage may change over time possibly becoming dominated by disturbance and shade tolerant species and/or weeds. These impacts may in turn affect use of the site by resident fauna populations.

The site contains relatively flat land 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 project, the proposed development would include the installation and operation of a double circuit 22kV overhead transmission line, approximately 2.7

km long, to connect the site to the existing Broken Hill substation. The proposed easement required for the overhead transmission line would be 30 metres wide and occurs on common land. There is currently an existing easement in this location and given the low natural growth forms of the shrubland communities on the property, clearing of vegetation is only required for the placement of poles and not along the length of the easement. Further, there is an existing vehicle track to be used for installation and maintenance of the easement and the disturbance to biodiversity is expected to be very low and only short-term in duration.

The existing transmission line that traverses the plant site will be realigned. This realignment will occur within a 20 metre easement around the north east corner of the site and, at a point along the northern boundary, will follow a route that traverses the north west corner of the site and reconnect to the existing transmission line near the western site boundary (Figure 1-1) . Disturbance to biodiversity in for the realignment in sections along the northern and eastern site boundary will not be in addition to disturbances already proposed in these locations. For example the perimeter road will be installed in the first initial stages of construction and will provide the necessary access for realignment of the transmission line.

The section of the realignment traversing the north west corner of the project site would require access along the proposed route for construction and maintenance. Disturbance estimates include the potential surface disturbance within the proposed 20 metre easement for this section of the realigned route.

The quoted figure of 149.3 hectares of disturbance over-estimates the area that would be directly impacted, as this has been based on the addition of a 30 metre wide corridor (8.1 ha). The actual construction of the transmission line would be restricted to disturbance around proposed pole sites only.

Access tracks would be provided inside and around the perimeter of the site to allow for maintenance of the site. Construction activities would commence with the building of site offices and facilities. Services such as power, water, sewer and communications would be connected to the site facilities. The entire site would be fenced to provide a secure work area and access roads to the site would be upgraded. The project is expected to remove habitat for the majority of the fauna currently using the site, including foraging habitat for the Black-breasted Buzzard and for the remaining threatened birds and Bolams Mouse. Once site works are complete, all temporary facilities and roadworks would be removed, services would be decommissioned and the site would be reinstated, as appropriate.

The project has potential to impact on the breeding pair of Black-breasted Buzzard during construction. This would be associated with construction noise and activity. As such construction should be timed to avoid breeding activity as determined by monitoring of the nest. Further details are discussed in Chapter 5. There is unlikely to be a significant impact on this breeding pair during the operation of the plant.

There is no published data on the potential impacts or monitoring of reflectively (solar glare) on raptors. The solar panels that would be installed as part of this project would be constructed of dark, light absorbing materials with very low glare potential. Therefore no negative impacts on the nesting raptors are anticipated.

4.2.1. Habitat connectivity

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The project will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

4.2.2. Construction Impacts

As described, the project will require the clearing of larger shrubs and small trees across most of the site to accommodate the PV project infrastructure and roads. An overlay of the concept plan design was used to quantify the extent of potential vegetation loss and is presented in Table 4-5. The proposal would impact on up to approximately 149.3 ha of existing vegetation from the site as a potential worst case scenario. The remaining portions of the property are cleared land and existing infrastructure. The proposed development also includes:

- Access road: proposed access to the site is via the current 8 metre wide unsealed access road from Barrier highway. As this road would be an adequate width to accommodate construction vehicles and equipment, no widening is proposed. The surface of the unsealed road will be investigated during detailed engineering to determine whether the surface requires an upgrade.
- Diversion of existing transmission line: the existing transmission line that dissects the plant site will be diverted around the north east corner of the solar PV plant and at a point along the northern boundary traverses the north west corner to rejoin the existing line at a point on the western site boundary.

- Table 4-4 Area of each map unit within the proposal area

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

As discussed previously the quoted figure of 149.3 hectares of disturbance over-estimates the area that would be directly impacted, as this has been based on the addition of a 30 metre wide transmission corridor (8.1 ha). The actual construction of the transmission line would be restricted to disturbance around proposed pole sites only.

There is potential for impacts on the identified nesting raptors during construction through noise and increased activity at the site, however there is potential to mitigate this impact as discussed in Chapter 5.

4.2.3. Operational Impacts

Once complete, the project is expected to have low operational impact on flora and fauna. Of note is the fact that there will be limited staff or vehicles on site during operation, albeit for occasional maintenance during daylight hours. There will be no artificial night lights required or noise as a consequence of the project's operation. Glare and dazzle effects due to reflection are expected to be minimal and are not expected to reflect light in a way that could potentially impact on the movements of birds over the site, such as the Black-breasted Buzzard.

4.2.4. Key Threatening Processes

The TSC Act and FM Act list Key Threatening Processes (KTP) as activities or processes that:

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

It is evident that the project would instigate some key threatening processes, such as clearing of native vegetation. Several other processes could be reasonably expected and have been discussed in Table 4-5 along with proposed measures to mitigate impacts.

- Table 4-5 Key threatening processes related to the project

Key threatening process (KTP)	Type of threat	Level of threat	Potential impacts	Impact mitigation measures
Invasion of native plant communities by exotic perennial grasses	Weed	Low	No exotic perennial grasses were identified on the site. These species are negatively associated with edge effects.	Weed management is to be developed as part of the on-site Environmental Management (Section 5.3)
Competition and grazing by the feral European rabbit	Pest animal	Low-Moderate	Evidence of European rabbit was recorded on the site. The project may provide additional areas of suitable habitat for European Rabbit.	The proposed mitigation measures would limit impacts from this KTP, in particular weed management and habitat restoration (Section 5.3).
Predation by feral cats	Pest animal	Low	The project may contribute to additional predation from feral cats by attracting cats to the site during construction.	The proposed mitigation measures would limit impacts from this KTP, in particular management of waste during construction (Section 5.3).
Predation by the European Red Fox	Pest animal	Low	The project may contribute to additional predation from European Red Fox, by attracting foxes to site during construction.	The proposed mitigation measures would limit impacts from this KTP, in particular management of waste during construction (Section 5.3).
Clearing of native vegetation	Habitat loss/ change	High	The project would result in the clearing or indirect disturbance of up to approximately 149.3 ha of native vegetation.	Where possible vegetation clearance would be minimised. Mitigation measures are detailed in Section 5.3).
Removal of dead wood and dead trees	Habitat loss/ change	Low	The project would result in the removal of dead Acacias, however these are not currently providing important habitat due to lack of size, structure and hollows.	Dead wood and dead trees would be relocated to adjacent areas of habitat (Section 5.3).
Increased sedimentation and erosion during construction	Habitat loss/ change	Moderate	There is potential for increased erosion during the construction process.	The proposed mitigation measures would limit impacts and will address potential increases in wind and water erosion from loss of vegetation.
Loss of aquatic and riparian habitats	Habitat loss/ change	Low	The project would require the removal of only a narrow width of riparian vegetation and a small artificial dam. The central drainage line is ephemeral with no standing water.	The proposed mitigation measures would limit impacts from this KTP, in particular weed management and habitat restoration (Section 6.3).

4.2.5. Significance Assessments

Environmental Planning and Assessment Act 1979

An assessment of the significance of impacts from this project in accordance with Part 3A of the *Environmental Planning & Assessment Act 1979* (as amended) has been conducted for known and potential threatened flora and fauna potentially affected by the project (refer Appendix A). The assessment is based on potential subject species as listed under Schedules 2 of the TSC Act. The assessment has concluded that the proposed project is unlikely to impose a significant impact on local populations of threatened fauna species or their habitats based on the nature of the proposed works being restricted to the site and small areas (pole locations) and the short term impacts associated with construction. A number of mitigation measures have been provided to further avoid and minimise the impacts on threatened species during construction.

This conclusion is based on the premise that the project will not significantly reduce the area of suitable habitat occurring in the surrounding landscape and indeed the wider bioregion. The site habitat was not found to support unique or significant areas of habitat for threatened flora or fauna.

Environment Protection and Biodiversity Conservation (EPBC) Act, 1999

The Proponent (AGL Energy Limited) has a statutory responsibility to comply with the requirements and intent of the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (EPBC Act) in relation to the protection and management of threatened species. No nationally threatened flora and fauna species, were identified on the site and none are expected to occur. On this basis, it is not considered that a formal assessment under the significance guidelines of the EPBC Act is required.

In regard to migratory species, the areas proposed for development of the PV project does not provide unique or critical habitat, preferred habitat, or habitat of significance for any migratory bird species. Construction of the project would not affect the visitation rates and behaviours of migratory species in the region.

5. Conclusions and Recommendations

5.1. Significant Ecological Values

The majority of the project site surveyed as part of the field study supports remnant vegetation in a near natural ecological condition, with some disturbances evident and associated with previous and current land-uses, as well as feral animals and weeds.

No state or federally listed threatened ecological communities, species or populations were identified from a survey of the site, however potential habitat is present for several threatened fauna species and a breeding pair of Black-breasted Buzzard (*Hamirostra melanosternon*) was tentatively identified on an adjacent site.

The assessment has also identified several areas of lower ecological value, comprising cleared land and land currently used for residential and recreational access and infrastructure where there is a distinct lack of vegetation including groundcover vegetation. This is particularly evident to the east of the site proposed for development of the transmission line corridor in the Willyama common lands.

5.2. Ecological Impacts

As the survey identified natural vegetation and fauna habitat on the site and within the proposed project area, a range of avoidance and mitigation measures are proposed and would form part of on-site environmental management works. The adoption of these recommendations would reduce the potential magnitude and extent of impacts from the project. The project will directly and indirectly impact on up to 149.3 ha of native vegetation. Operational and indirect impacts on remaining habitats on the site will be managed through a plan to restore vegetation along perimeter areas and outside of the development area.

The assessments of significance have concluded that the proposed project in itself is unlikely to impose a significant impact on local populations of threatened species, endangered communities or their habitats as listed under the TSC Act and EPBC Act, on the basis that the site habitats are uniform and well represented across the landscape and indeed the wider Broken Hill Complex bioregion. The habitats to be impacted are not specifically unique in this landscape or represent a significant site for a population of a threatened species. However, this project will contribute to the potential cumulative loss of habitat in the region in the longer-term.

5.3. Biodiversity offsetting measures

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

The project aims to maintain or improve biodiversity over time. To achieve this, a biodiversity offset strategy will be prepared that identifies a proposed offset site and the vegetation types to be preserved and outlines measures to manage the site including reducing current threats to biodiversity. The offsetting measures should also include a plan to restore and remove threats from the proposed un-developed portions of the site (i.e. 60 hectares).

The availability of offsets in the locality are illustrated in Figure 5.1, which identifies the extent of similar vegetation types surrounding the project site.

5.4. Recommendations

The condition of the vegetation and fauna habitats in the study area and the nature of the project suggest that particular care and consideration is required during each phase of the project (i.e. construction and operation) to minimise threats and conserve areas of conservation value to flora and fauna. The following section provides advice and recommendations to achieve this objective:

- There is scope to restore degraded and cleared portions of the site outside of the development footprint (i.e. site perimeter) and this may assist in buffering the negative effects of wind erosion, and additionally provide access across the site by wide-ranging species such as Emus and Kangaroos attempting to access adjacent habitats as well as control weeds. In this regard the proposed Biodiversity Offset Strategy should include measures to restore the natural vegetation on the un-developed portions of the site through weed and rubbish removal to assist natural regeneration. This could include the closure and rehabilitation of existing vehicle and recreational tracks that do not fall within the development footprint. The plan should be prepared prior to construction and will identify the areas of focus for remediation and weed control, provide a set of objectives and actions required to restore, maintain and monitor the success of the plan with an adaptive approach.
- Install speed reduction measures along internal access roads, wildlife signage and sensor lighting to minimise disturbance from noise and lighting on nocturnal fauna. The Landscape Plan should include landscaping along the road verges and disturbed edges of the development.

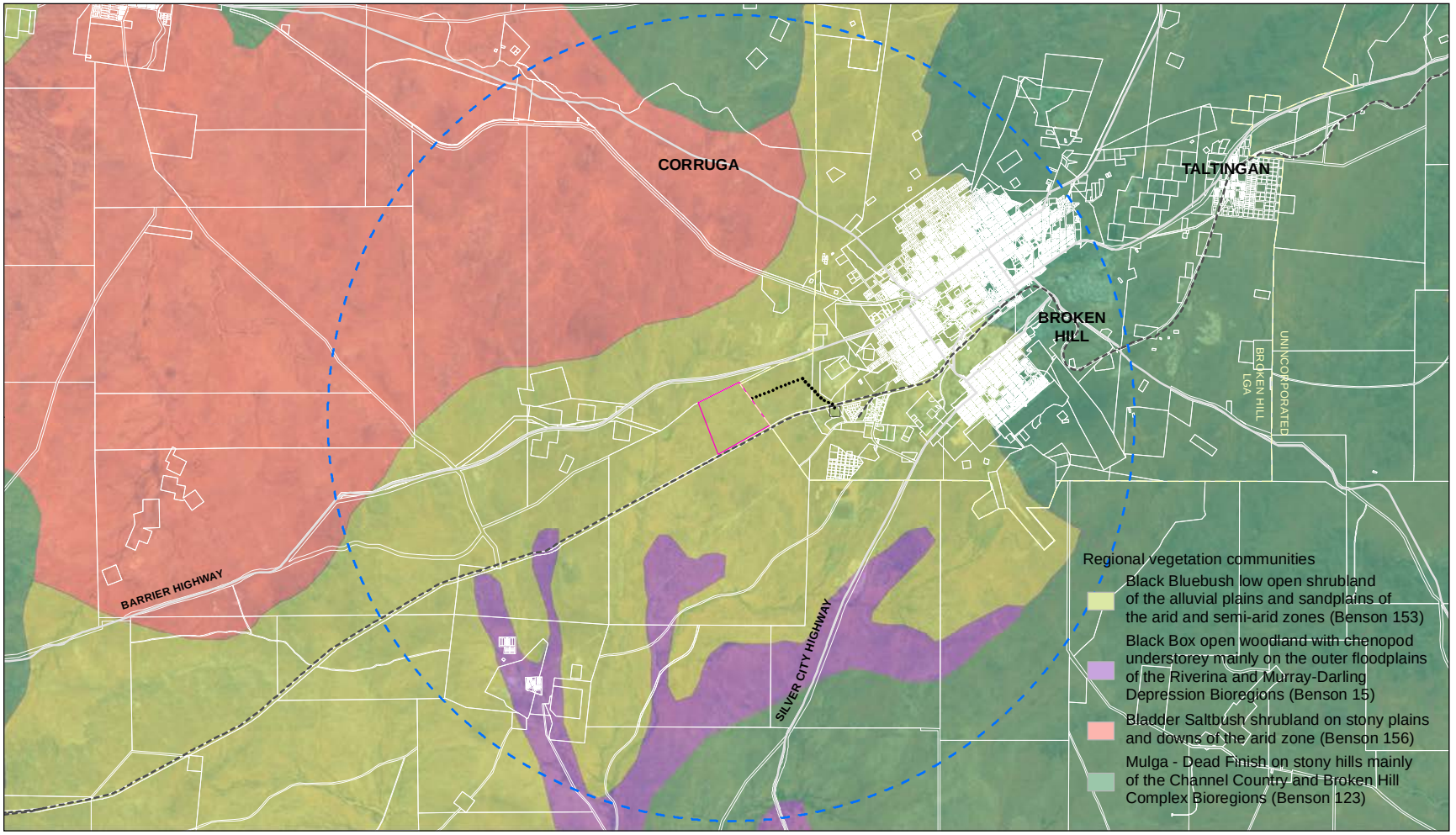

Figure 5-1 Regional vegetation communities and availability of offsets

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Spatial Team - Prepared by : JC
Checked by : JL

- Prepare a sediment and erosion plan as part of the on-site construction environmental management objectives. The direct and indirect impacts on vegetation are likely to lead to long-term changes in the floristic structure and composition, reducing the extent of natural vegetation groundcover. Increased erosion potential should be managed by selective regeneration in buffer areas and physical placement of erosion barriers such as straw bales.

- A non-construction buffer of 500 m radius should be placed around the Black-breasted Buzzard nest site (if present at the time of construction) and no construction vehicles or personnel should enter the buffer unless assessed for the presence of buzzards.

- A plan to control feral animals (rabbits, goats and cats) is to be prepared outlining methods for annual control and measures to reduce the presence of these species during construction and operation. This may include measures to reduce unnecessary waste and placement of garbage bins during construction. Food scraps may act to encourage feral animals to the site and in turn impact on native fauna. the plan can be outlined in the biodiversity offset strategy.

- In order to minimise the impacts of construction noise and activity on the raptor nest on the adjoining property, the following steps are recommended:
  - If possible avoid construction during the breeding season (August to October)
  - Prior to construction check and monitor the nest over a three day period to determine if the nest is active or inactive.
  - If active, post-pone construction until after young have fledged this is to be determined by a fortnightly check of the nest.
  - Following construction, monitor nesting activity during the annual breeding season to determine if the nest is continuing to be used. If there is evidence of abandonment of the nest after a period of three years, further consultation is to be conducted with OEH regarding options for placement of an artificial nest structure.

5.5. Effectiveness of the Proposed Mitigation Measures

Potential impacts on biodiversity as a result of the project can be minimised where possible through interpretation of the flora and fauna data derived from the field surveys. This data was used to describe and illustrate the ecological values, constraints and opportunities and hence guide decisions relating to avoidance and minimising impacts.

The recommended management actions are a tool to minimise impacts during the construction and operation of the project. The outcome would include the restoration of currently cleared and degraded portions of the site and target the planting and restoration of natural habitats that would minimise erosion and provide habitat for flora and fauna including threatened species. To ensure the effectiveness of the restoration works, the outcomes of the plan should be monitored.

Details of the proposed management actions for the offset site and un-developed portions of the site should be outlined in a biodiversity offset strategy in consultation with OEH. The strategy should include proposed performance monitoring measures and adaptive management.

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Appendix A Assessment of Significance

A.1 Environmental Planning and Assessment Act, 1979

Black-breasted Buzzard (*Hamirostra melanosternon)*

How is the project likely to affect the lifecycle of a threatened species and/or population?

A single adult bird was observed sitting on a large nest, located approximately 500 m to the west of the site. The bird was tentatively identified as a Black-breasted Buzzard. The nest would not be directly affected and it is proposed to enforce a 500 m construction buffer around the nest. It is expected that the site occurs within the home range of a breeding pair and the project will not directly affect the nest or the breeding life-cycle events and measures to avoid impacts during construction have been recommended. It would potentially impact on the cumulative area of shrubland habitat currently used by this pair for foraging and on the availability of habitat for prey species.

Black-breasted buzzard exhibits large home ranges and uses a variety of habitat types for foraging, favouring woodland and riparian tree cover as well as shrubland and grasslands (Aumann 2001a) foraging on a range of prey species including reptiles, mammals and birds (Aumann 2001b). The shrubland habitats on the project site provide potential foraging habitat, however other taller woodland and mulga habitats in the locality surrounding Broken Hill are also expected to provide important foraging habitat. The proposed direct and indirect loss of vegetation from the site, would impact on a relatively small area of habitat for prey species, similar habitats are widespread throughout the range of pair. While there may be some short to medium terms impacts during construction, the project is not expected to have a long-term negative impact on the foraging or breeding life-cycle activities of the local pair.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project will remove up to approximately ~149.3 ha of habitat for prey species from the home range territory of a breeding pair, therefore reducing the area of foraging habitat. The importance of the site for foraging is not known and the habitats to be affected are common and widespread in the surrounding landscape suggesting that the site is not significantly different from other shrubland habitats in the locality and the total clearing is therefore a very small percentage of the foraging habitat available to the pair.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The species occurs throughout the arid interior of central Australia as well as tablelands, generally west of the divide in NSW and through central Queensland and Northern Territory. The study area is not the limit of distribution for this species.

How is the project likely to affect current disturbance regimes?

The current disturbance regimes on the site include minor weed invasion, soil erosion, and predation and grazing from feral animals. The project has potential to increase opportunities for weeds and feral animals through physical alteration of the landscape. It is proposed to manage this impact through implementation of a landscape management plan and environmental management plan, including weed and feral animal control measures as well as a monitoring program and adaptive management approach. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The proposal will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW under the TSC Act.

Arid shrubland birds (Redthroat, Rufous Fieldwren, White-fronted Chat)

How is the project likely to affect the lifecycle of a threatened species and/or population?

These species were not recorded on the site from detailed and targeted surveys across all potential habitat areas. However suitable habitat for these species is associated with the chenopod shrubland and mulga scrub and is represented across all portions of the site. Therefore the project will remove potential foraging, breeding and nesting habitat from the locality, occupying up to approximately 149.3 ha of potential habitat. Potential habitat for these species is common and widespread in the locality and indeed the wider Broken Hill complex bioregion. The project is not expected to involve a significant loss of potential habitat in terms of area or impact of an area of unique habitat in the landscape.

If indeed these species do occur in the area, the loss may impact on the home range territory of several pairs, remove a percentage of the shelter and foraging resources for these birds and potentially disrupt a breeding season. The number of animals affected in relation to the size of local population is not known, however records are widespread throughout the region and it could be reasonably expected the proportion of the population impacted would be minor and not lead to a significant impact on the population as a whole.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove up to approximately 149.3 ha of potential habitat potentially resulting in the loss of foraging and breeding habitat and may have a short term impact on food resources for a small number of birds. However, the habitats suited to these species are particularly well represented and widespread in the region. The overall reduction of habitat is considered a small proportion of the available potential habitat. Potential populations are considered to persist in adjoining properties following development of the project. The lack of records of these species reported from the field survey suggests that the habitat to be removed is only marginal.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution for any of these species which occur through much of southern arid and semi-arid Australia.

How is the project likely to affect current disturbance regimes?

The current disturbance regimes on the site include minor weed invasion, soil erosion, and predation and grazing from feral animals. The project has potential to increase opportunities for

weeds and feral animals through physical alteration of the landscape. It is proposed to manage this impact through implementation of a landscape plan and environmental management plan, including weed and feral animal control measures as well as a monitoring program and adaptive management approach. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The proposal will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW under the TSC Act.

Australian Bustard

How is the project likely to affect the lifecycle of a threatened species and/or population?

The species was not recorded on the site from detailed and targeted surveys across all potential habitat areas. Suitable habitat for this species on the site is associated with the chenopod shrubland and mulga scrub and tussock grassland and is represented across all portions of the site. Therefore the project will remove potential foraging habitat and may disrupt foraging activities for a small number of birds. Forages on insects, and young birds, lizards, mice. leaves, seeds and fruit. These food resources are abundant and widespread in the locality and not unique to the project site. The project is not expected to involve a significant loss of food resources or potential habitat.

The birds breed on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on the ground among shrubs and long grasses or under trees. Apparently breeding only known from the northwest region of NSW, so the project is unlikely to impact on breeding life-cycle events.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove up to approximately 149.3 ha of potential foraging habitat and may have a short term impact on food resources for a very small number of birds. However, the habitats suited to these species are particularly well represented and widespread in the region. The overall reduction of habitat is considered a small proportion of the available potential habitat. Potential populations are considered to persist in adjoining properties following development of the project. The lack of records of these species reported from the field survey and region suggests that the habitat to be removed is only marginal or that regional populations are small.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution for the Redthroat. It occurs through much of the western plains regions of New South Wales and southern arid and semi-arid inland Australia.

How is the project likely to affect current disturbance regimes?

The current disturbance regimes on the site include minor weed invasion, soil erosion, and predation and grazing from feral animals. The project has potential to increase opportunities for weeds and feral animals through physical alteration of the landscape. It is proposed to manage this impact through implementation of a landscape plan and environmental management plan,

including weed and feral animal control measures as well as a monitoring program and adaptive management approach. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The proposal will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW under the TSC Act.

Pied Honeyeater

How is the project likely to affect the lifecycle of a threatened species and/or population?

The species was not recorded on the site from detailed and targeted surveys across all potential habitat areas. Suitable habitat for this species is associated with wattle shrub (primarily Mulga, *Acacia aneura*), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (Eremophila spp.); also from mistletoes and various other shrubs (e.g. Grevillea spp.); also eats saltbush fruit, berries, seed, flowers and insects. The chenopod shrubland and mulga scrub represents potential habitat is represented across all portions of the site.

Therefore the project will remove potential foraging, breeding and nesting habitat from the locality, occupying up to approximately 149.3 ha of potential habitat. Potential habitat for this species is common and widespread in the locality and indeed the wider Broken Hill complex bioregion. The project is not expected to involve a significant loss of potential habitat in terms of area or impact of an area of unique habitat in the landscape. The species is highly nomadic, following the erratic flowering of shrubs; can be locally common at times.

If the species does occur in the area, the loss may remove a percentage of the shelter and foraging resources for these birds. However due to the nomadic movements of the species, the impact is unlikely to be significant on a local or regional scale. .

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove up to approximately 149.3 ha of potential habitat potentially resulting in the loss of foraging and breeding habitat and may have a short term impact on food resources for a very small number of birds. However, the habitats suited to these species are very well represented and widespread in the region. The overall reduction of habitat is considered a small proportion of the available potential habitat. Opportunities for this species are considered to persist in adjoining properties following development of the project.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution. The species is widespread throughout acacia, mallee and spinifex scrubs of arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought.

How is the project likely to affect current disturbance regimes?

The current disturbance regimes on the site include minor weed invasion, soil erosion, and predation and grazing from feral animals. The project has potential to increase opportunities for weeds and feral animals through physical alteration of the landscape. It is proposed to manage this impact through implementation of a landscape plan and environmental management plan, including weed and feral animal control measures as well as a monitoring program and adaptive management approach. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The proposal will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW under the TSC Act.

Spotted Harrier

How is the project likely to affect the lifecycle of a threatened species and/or population?

The species was not recorded on the site from detailed and targeted surveys across all potential habitat areas. Suitable habitat for this species is associated with grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrubland. The chenopod shrubland and mulga scrub on the site provide marginal habitats for the species which preys on terrestrial mammals (e.g. bandicoots, bettongs and rodents) birds and reptiles.

Therefore the project will remove potential foraging habitat. As the species build nests in trees, there are very limited opportunities for nesting and breeding activities on the site and the impact of the project would be associated with loss of habitat for prey species. Potential habitat for this species is common and widespread in the locality and indeed the wider Broken Hill complex bioregion. The project is not expected to involve a significant loss of potential prey habitat in terms of area or impact of an area of unique habitat in the landscape.

The number of animals affected in relation to the size of local populations is not known, however records are widespread and it could be reasonably expected the proportion of the population impacted would be minor and not lead to a significant impact on the population as a whole.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove up to approximately 149.3 ha of potential hunting habitat potentially resulting in the loss of prey species and may have a short term impact on food resources for a small number of birds. However, the habitats suited to these species are particularly well represented and widespread in the region. The overall reduction of habitat is considered a small proportion of the available potential habitat. Potential populations are considered to persist in adjoining properties following development of the project.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution for this species. The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. Individuals disperse widely in NSW and comprise a single population.

How is the project likely to affect current disturbance regimes?

The current disturbance regimes on the site include minor weed invasion, soil erosion, and predation and grazing from feral animals. The project has potential to increase opportunities for weeds and feral animals through physical alteration of the landscape. It is proposed to manage this impact through implementation of a landscape plan and environmental management plan, including weed and feral animal control measures as well as a monitoring program and adaptive management approach. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The proposal will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW under the TSC Act.

Bolams Mouse

How is the project likely to affect the lifecycle of a threatened species and/or population?

Suitable habitat for this species is associated with chenopod shrubland plains or low mallee woodland where there is a developed understorey of Acacia, Dodonaea or Eremophila species. It seems to especially favour plains areas, spillways and along valley bottoms where loam or clay soils occur. It has been recorded in four broad vegetation types in Tarawi Nature Reserve: Mallee-spinifex, Mallee shrubland, Belah woodland and Mixed open shrubland/woodland.

The diet consists of seeds, fruits, blossoms, grasses and herbs as well as invertebrates such as beetles and spiders. Increased capture rates have been made in areas with a high cover of bluebush (*Maireana* spp.), with the seeds recorded as a food source.

Within the project site the chenopod shrubland and mulga scrub represents potential habitat and these habitats are well represented across all portions of the site. Therefore the project will remove potential foraging and breeding habitat from the locality, occupying up to approximately 149.3 ha of potential habitat.

Potential habitat for this species is common and widespread in the locality and indeed the wider Broken Hill complex bioregion. The project is not expected to involve a significant loss of potential habitat in terms of area or impact of an area of unique habitat in the landscape. If the species does occur in the area, the loss may impact on the home range territory of several individuals, remove a percentage of the shelter and foraging resources for the species and potentially disrupt a breeding season. The number of animals affected in relation to the size of local population is not known, however given the widespread nature of the habitat it could be reasonably expected the proportion of the population impacted would be minor and not lead to a significant impact on local and regional populations.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove up to approximately 149.3 ha of potential habitat potentially resulting in the loss of foraging and breeding habitat and may have a short term impact on life-cycle activities for a very small proportion of local and regional populations.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution for this species. This species is found in southern Western Australia and South Australia, extending east into the south-western corner of NSW

How is the project likely to affect current disturbance regimes?

The current disturbance regimes on the site include minor weed invasion, soil erosion, and predation and grazing from feral animals. The project has potential to increase opportunities for weeds and feral animals through physical alteration of the landscape. It is proposed to manage this impact through implementation of a landscape plan and environmental management plan, including weed and feral animal control measures as well as a monitoring program and adaptive management approach. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The proposal will not increase fragmentation of habitat or significantly reduce the amount of habitat in the locality. The habitat on the site is uniform across the surrounding landscape and the site is not located in an obvious wildlife corridor, nor will the connectivity of habitat in the landscape be significantly affected. The proposal will include landscaping of the perimeter of the site and this will assist fauna movements across the site.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW under the TSC Act.

A.2 Environment Protection and Biodiversity Conservation Act, 1999

The assessment considers the potential significance of impacts on migratory listed species under the EPBC Act. No threatened nationally listed flora or fauna or endangered ecological communities were recorded on the site or are expected to occur.

Migratory species

Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

No listed migratory bird species (EPBC Act) were identified from the field investigation; however the White-throated Needletail (*Hirundapus caudacutus*) and Lathams Snipe (Gallinago hardwickii) is considered to potentially occur based on the habitat assessment.

The White-throated Needletail is an aerial forager that is generally observed in the air and has no specific or documented habitat preferences. There is no evidence to suggest that an area of important habitat exists in the study area for this species.

Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). The small artificial dam and associated drainage areas provides very marginal habitat for this species, particularly given the presence of much larger potential habitats throughout the western districts.

There are no breeding records from the site or surrounds and the extent of habitat remaining in the study area would provide sufficient resources to sustain future visitation. The project would not reduce populations of either species nor substantially reduce the extent of potential habitat in the region.

Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species

There is no evidence to suggest that an area of important habitat exists in the study area for any listed migratory species. Suitable measures would be incorporated into the project to control the spread of weeds during the construction and operation and these are to be detailed in a habitat restoration plan.

Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

There is no evidence to suggest that an area of important habitat exists or that the study area is occupied by an ecologically significant proportion of a population of a migratory species.

Appendix B Flora Species List

KEY TO APPENDIX B

ABBREVIATIONS:

i = introduced (i.e. not indigenous to Australia)
n = native Australian species not considered to be indigenous to the site
c = cultivated (i.e. planted on the site)
t = listed as a threatened species under State and/or Commonwealth legislation
spp. = unidentified species[2]
sp. aff. = unidentified species with characteristics similar to the indicated species or genus[2]
? = unconfirmed species[2]
r = RoTAP species (Briggs and Leigh 1996)
var. = variety
subsp. = subspecies
cv. = cultivar (i.e. a anthropogenic form of the species)
agg. = an aggregate of several yet to be defined species

NOTES:

1. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons.
2. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material, etc.

SCIENTIFIC NAMES & AUTHORITIES:

Scientific names & families are those used in the *Flora of New South Wales* as maintained by the Royal Botanic Gardens (http://.plantnet.rbgsyd.gov.au).
Orders and higher taxa are based on Angisperm Phylogeny Group (2003).
For the sake of simplicity, scientific names in this list do not include authorities. These can be found in the *Flora of New South Wales.*

	Family	Scientific Name	Common Name	
Ferns				
	ADIANTACEAE	*Cheilanthes lasiophylla*	Wooly Cloak-fern	
	MARSILEACEAE	*Marsilea drummondii*	Common Nardoo	
Flowering Plants - Dicotyledons				
	AIZOACEAE	*Mesembryanthemum crystallinum*	Common Ice Plant	i
	AIZOACEAE	*Sarcozona praecox*	Sarcozona	
	AIZOACEAE	*Tetragonia tetragonioides*	New Zealand Spinach	
	AMARANTHACEAE	*Alternanthera denticulata*	Lesser Joyweed	
	AMARANTHACEAE	*Amaranthus* sp.	Amaranth	i
	AMARANTHACEAE	*Ptilotus obovatus var. obovatus*	Silver Tails	
	ANACARDIACEAE	*Schinus areira*	Pepper tree	i
	APOCYNACEAE	*Marsdenia australis*	Doubah	
	ASTERACEAE	*Brachyscome ciliaris var. lanuginosa*	Variable Daisy	
	ASTERACEAE	*Brachyscome nodosa*		
	ASTERACEAE	*Carthamus lanatus*	Saffron Thistle	i
	ASTERACEAE	*Centipida cunninghamii*	Sneeze Weed	
	ASTERACEAE	*Centaurea melitensis*	Maltese Cockspur	i
	ASTERACEAE	*Conyza bonariensis*	Fleabane	i

	Family	Scientific Name	Common Name	
	ASTERACEAE	*Gnephosis arachnoidea*		
	ASTERACEAE	*Leiocarpa brevicompta*	Flat Billy-buttons	
	ASTERACEAE	*Leiocarpa semicalva subsp. semicalva*		
	ASTERACEAE	*Minuria cunninghamii*		
	ASTERACEAE	*Pseudognaphalium luteo-album*	Jersey Cudweed	
	ASTERACEAE	*Reichardia tingitana*	False Sowthistle	i
	ASTERACEAE	*Senecio magnificus*	Tall Yellow-top	
	ASTERACEAE	*Sonchus oleraceus*	Common Sow-thistle	i
	ASTERACEAE	*Vittadinia eremaea*		
	BORAGINACEAE	*Echium plantagineum*	Pattersons Curse	i
	BORAGINACEAE	*Heliotropium curassavicum*	Smooth Heliotrope	
	BRASSICACEAE	*Arabidella trisecta*		
	BRASSICACEAE	*Carrichtera annua*	Ward's Weed	i
	BRASSICACEAE	*Lepidium phlebopetalum*	Veined Peppercress	
	CHENOPODIACEAE	*Atriplex angulata*	Fan Saltbush	
	CHENOPODIACEAE	*Atriplex conduplicata*		
	CHENOPODIACEAE	*Atriplex lindleyi*		
	CHENOPODIACEAE	*Atriplex pseudocampanulata*		
	CHENOPODIACEAE	*Atriplex quinii*		
	CHENOPODIACEAE	*Atriplex spongiosa*	Pop Slatbush	
	CHENOPODIACEAE	*Atriplex stipitata*	Mallee Saltbush	
	CHENOPODIACEAE	*Atriplex suberecta*	Sprawling Saltbush	
	CHENOPODIACEAE	*Atriplex velutinella*	Sandhill Saltbush	
	CHENOPODIACEAE	*Atriplex vesicaria*	Bladder Saltbush	
	CHENOPODIACEAE	*Chenopodium curvispicatum*		
	CHENOPODIACEAE	*Dissocarpus biflorus var. biflorus*		
	CHENOPODIACEAE	*Dissocarpus paradoxus*	Cannonball Burr	
	CHENOPODIACEAE	*Enchylaena tomentosa*	Ruby Saltbush	
	CHENOPODIACEAE	*Maireana astrotricha*	Low Bluebush	
	CHENOPODIACEAE	*Maireana integra*		
	CHENOPODIACEAE	*Maireana pentatropis*	Erect Mallee Bush	
	CHENOPODIACEAE	*Maireana pyramidata*	Black Bluebush	
	CHENOPODIACEAE	*Maireana sclerolaenoides*		
	CHENOPODIACEAE	*Maireana sedifolia*	Pearl Bluebush	
	CHENOPODIACEAE	*Maireana spongiocarpa*		
	CHENOPODIACEAE	*Maireana villosa*	Silky Bluebush	
	CHENOPODIACEAE	*Osteocarpum acropterum var. acropterum*		
	CHENOPODIACEAE	*Rhagodia spinescens*	Spiny Saltbush	
	CHENOPODIACEAE	*Rhagodia ulicina*	Spiny Goosefoot	
	CHENOPODIACEAE	*Salsola kali var. kali*	Prickly Saltwort	
	CHENOPODIACEAE	*Sclerolaena articulata*		
	CHENOPODIACEAE	*Sclerolaena bicornis*	Goathead Burr	
	CHENOPODIACEAE	*Sclerolaena brachyptera*		
	CHENOPODIACEAE	*Sclerolaena constricta*		
	CHENOPODIACEAE	*Sclerolaena divaricata*	Tangled Copperburr	
	CHENOPODIACEAE	*Sclerolaena eriacantha*		

	Family	Scientific Name	Common Name	
	CHENOPODIACEAE	*Sclerolaena lanicuspis*	Woolly Copperburr	
	CHENOPODIACEAE	*Sclerolaena limbata*		
	CHENOPODIACEAE	*Sclerolaena obliquicuspis*	Limestone Bindii	
	CHENOPODIACEAE	*Sclerolaena tricuspis*	Giant Redburr	
	CHENOPODIACEAE	*Sclerolaena ventricosa*	Salt Copperburr	
	CONVOLVULACEAE	*Convolvulus clementii*	Desert Bindweed	
	CONVOLVULACEAE	*Convolvulus microsepalus*	Small-flower Bindweed	
	CUCURBITACEAE	*Cucumis myriocarpus subsp. leptodermis*		i
	EUPHORBIACEAE	*Chamesayce drummondii*	Caustic Weed	
	FABACEAE-CAESALPINIOIDEAE	*Senna form taxon 'artemisioides'*	Silver Cassia	
	FABACEAE-CAESALPINIOIDEAE	*Senna form taxon 'coriacea'*		
	FABACEAE-CAESALPINIOIDEAE	*Senna form taxon 'filifolia*		
	FABACEAE-CAESALPINIOIDEAE	*Senna phyllodinea*		
	FABACEAE-FABOIDEAE	*Glycine rubiginosa*		
	FABACEAE-FABOIDEAE	*Lotus cruentus*	Red-flowered Lotus	
	FABACEAE-FABOIDEAE	*Medicago laciniata*	Cut-leaved Medic	i
	FABACEAE-FABOIDEAE	*Medicago polymorpha*	Burr Medic	i
	FABACEAE-FABOIDEAE	*Swainsona fissimontana*		
	FABACEAE-FABOIDEAE	*Swainsona formosa*	Sturt's Desert Pea	
	FABACEAE-FABOIDEAE	*Vicia monantha*	Square-stemmed Vetch	i
	FABACEAE-MIMOSOIDEAE	*Acacia aneura*	Mulga	
	FABACEAE-MIMOSOIDEAE	*Acacia burkittii*	Sand Hill Wattle	
	FABACEAE-MIMOSOIDEAE	*Acacia oswaldii*	Miljee	
	FABACEAE-MIMOSOIDEAE	*Acacia tetragonophylla*	Dead Finish	
	FABACEAE-MIMOSOIDEAE	*Acacia victoriae*	Prickly Wattle	
	FABACEAE-MIMOSOIDEAE	*Prosopis velutina*	Velvet Mesquite	
	GENTIANACEAE	*Centaurium tenuiflorum*		i
	GERANIACEAE	*Erodium spp.*	Storksbill	i
	GOODENIACEAE	*Goodenia fascicularis*		
	GOODENIACEAE	*Goodenia lunata*	Stiff Goodenia	
	LAMIACEAE	*Salvia verbenaca*	Vervain	i
	LORANTHACEAE	*Amyema preissii*		
	MALVACEAE	*Abutilon leucopetalum*		
	MALVACEAE	*Hibiscus brachysiphonius*	Low Hibiscus	
	MALVACEAE	*Hibiscus krichauffianus*	Velvet-leaf Hibiscus	

	Family	Scientific Name	Common Name	
	MALVACEAE	*Sida corrugata*	Corrugated Sida	
	MALVACEAE	*Sida cunninghamii*	Ridged Sida	
	MALVACEAE	*Sida intricata*	Twiggy Sida	
	MALVACEAE	*Sida petrophila*		
	MYOPORACEAE	*Eremophila sturtii*	Narrow-leaf Emu-bush	
	MYOPORACEAE	*Myoporum montanum*	Western Boobialla	
	NITRARIACEAE	*Nitraria billardierei*	Nitre Bush	
	PLANTAGINACEAE	*Plantago drummondii*		
	POLYGONACEAE	*Polygonum arenastrum*	Common Wireweed	
	PORTULACACEAE	*Portulaca olearacea*	Pigweed	
	SAPINDACEAE	*Dodonaea viscosa subsp. angustissima*	Narrow-leaf Hopbush	
	SOLANACEAE	*Lycium australe*	Australian Boxthorn	
	SOLANACEAE	*Solanum sturtianum*	Thargomindah Nightshade	
	VERBENACEAE	*Verbena supina*	Trailing Verbena	i
	ZYGOPHYLLACEAE	*Zygophyllum eremaeum*	Climbing Twinleaf	
Flowering Plants - Monocotyledons				
	ANTHERICACEAE	*Thysanotus baueri*		
	ASPHODELACEAE	*Asphodelus fistulosus*	Onion Weed	i
	ASPHODELACEAE	*Bulbine semibarbata*	Native Leek	
	POACEAE	*Aristida contorta*	Bunched Kerosene Grass	
	POACEAE	*Austrodanthonia* spp	Wallaby Grass	
	POACEAE	*Austrodanthonia caespitosa*	Wallaby Grass	
	POACEAE	*Austrostipa scabra*	Speargrass	
	POACEAE	*Bromus arenarius*	Sand Brome	
	POACEAE	*Chloris truncata*	Windmill Grass	
	POACEAE	*Cymbopogon ambiguus*	Scent Grass	
	POACEAE	*Cynodon dactylon*	Common Couch	
	POACEAE	*Dichanthium sericeum* subsp. *sericeum*	Queensland Bluegrass	
	POACEAE	*Enneapogon avenaceus*	Bottle Washers	
	POACEAE	*Enneapogon polyphyllus*	Leafy Nineawn	
	POACEAE	*Eragrostis dielsii*	Mallee Lovegrass	
	POACEAE	*Eragrostis eriopoda*	Woollybutt Grass	
	POACEAE	*Panicum decompositum*	Native Millet	
		Total Flora Species	127	
		Total Introduced Species	19	
		Total Monocot Species	17	
		Total Dicot Species	108	
		Total Fern Species	2	
		Total Conifer Species	0	
		Total Families	32	
		Total Threatened Species	0	

Appendix C Fauna Species List

Family / Scientific name	Common name
BIRDS	
Casuariidae	
Dromaius novaehollandiae	Emu
Accipitridae	
Haliastur sphenurus	Whistling Kite
Milvus migrans	Black Kite
Hamirostra melanosternon	Black-breasted Buzzard (Vulnerable TSC Act)
Falconidae	
Falco cenchroides	Nankeen Kestrel
Rallidae	
Gallinula ventralis	Black-tailed Native-hen
Turnicidae	
Turnix velox	Little Button-quail
Charadriidae	
Erythrogonys cinctus	Red-kneed Dotterel
Elseyornis melanops	Black-fronted Dotterel
Columbidae	
Geopelia cuneata	Diamond Dove
Ocyphaps lophotes	Crested Pigeon
Psittacidae	
Melopsittacus undulatus	Budgerigar
Tytonidae	
Tyto alba	Barn Owl
Maluridae	
Malurus splendens	Splendid Fairy-wren
Malurus leucopterus	White-winged Fairy-wren
Meliphagidae	
Epthianura tricolor	Crimson Chat
Lichenostomus virescens	Singing Honeyeater
Artamidae	
Gymnorhina tibicen	Australian Magpie
Corvidae	
Corvus bennetti	Little Crow
Corvus coronoides	Australian Raven
Alaudidae	
Mirafra javanica	Horsefield's Bushlark
Motacillidae	
Anthus australis	Australian Pipit
Estrildidae	
Taeniopygia guttata	Zebra Finch
Hirundinidae	
Petrochelidon ariel	Fairy Martin

Family / Scientific name	Common name
Sylviidae	
Cincloramphus cruralis	Brown Songlark
MAMMALS	
Tachyglossidae	
Tachyglossus aculeatus	Short-beaked Echidna
Macropodidae	
Macropus fuliginosus	Western Grey Kangaroo
Macropus rufus	Red Kangaroo
INTRODUCED	
Canidae	
Canis lupus	Dingo, domestic dog
Vulpes vulpes	Fox
Leporidae	
Oryctolagus cuniculus	Rabbit
Equidae	
Equus caballus	Horse
REPTILES	
Gekkonidae	
Gehyra variegata	Tree Dtella
Agamidae	
Amphibolurus nobbi	Nobbi
Varanidae	
Varanus gouldii	Gould's Goanna
Scincidae	
Ctenotus robustus	Robust Ctenotus
Morethia obscura	Shrubland Morethia Skink