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Partnerships in protecting rockholes: 2009-10 cultural and ecological site assessments in the Gawler Ranges

PARTNERSHIPS IN PROTECTING ROCKHOLES: 2009-10 CULTURAL AND ECOLOGICAL SITE ASSESSMENTS IN THE GAWLER RANGES

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Report to the South Australian Arid Lands Natural Resources Management Board.

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Cover images: Kulkalla Rock-hole, Yardea Station.

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SA Arid Lands Natural Resources Management Board

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

This report presents the ecological and cultural site assessments undertaken for the SAAL NRM Board project 'Combining cultural and ecological knowledge to develop a regional and cultural land management strategy'. This project has evolved since 2008 as a partnership between the South Australian Arid Lands Natural Resources Management (SAAL NRM) Board, the Gawler Ranges native title claim group (GRNTCG), the South Australian Native Title Services Ltd (SANTS), and the Department for Water (DFW) of the State Government. The project stemmed from the interests, aspirations and requests of members of the Gawler Ranges native title claim group to look after country and in particular rock-holes. Through the support of the SAAL NRM Board, the project partners have developed a collaborative approach to assess the cultural and ecological value of rock-holes as a first step in managing these significant traditional water resources.

The cultural and ecological information available on rock-holes across the SAAL NRM Board region is limited. Importantly, this project aimed to develop an inventory of culturally important rock-holes in the Gawler Ranges and record baseline ecological and cultural data. While some cultural information is not able to be presented in this report, the Gawler Ranges native title claim group has established a Cultural and Ecological Information Management System (CEIMS) to store and manage any such information. The details of this database are included in the fourth report of this reporting series.

Significant to the success of the project is the ongoing participation of the Gawler Ranges native title claim group and also the pastoralists and landholders to ensure the future management, protection and improved knowledge of rock-holes. Historically, rock-holes were valued by pastoralists for their importance as stock watering sites prior to the establishment of more permanent water points, i.e. bores and dams. Today there is widespread interest amongst pastoralists in understanding and maintaining the ecological value, cultural significance and historical importance of rock-holes in the landscape. The project has presented the cultural and ecological significance of rock-holes in the Gawler Ranges and established a framework and methodology for a collaborative approach to rock-hole identification, assessment and management.

This report details the ecological and cultural data collected from eighteen of the 21 sites visited across seven pastoral leases within the Gawler Ranges. From the cultural assessment, many of the rock-holes visited were associated with Aboriginal law or *Tjukurrpa* which forms part of a rich cultural landscape passed from generation to generation through story, song and dance. The members of the native title group spoke of these *dreaming* stories during field work which highlights the cultural significance of the rock-holes. Furthermore, the value of water across this arid landscape was emphasised, with rock-holes being well-known and cared for by generation after generation of traditional owners. The field trips gave traditional owners the opportunity to reconnect with cultural sites that they hadn't visited for a long time and allowed them to show and tell their younger family members about the sites. The elders spoke of the field trips as cleansing and invigorating experiences for both self and country. Rock-holes were also spoken of in terms of traditional productive values, with rock-hole complexes providing important resource utilisation areas rich in bush tucker and bush medicines.

The ecological survey supported these cultural findings, as the vegetation associated with the granite rock outcrops differed from the surrounding saltbush landscape. The rocky outcrops specifically supported a more diverse vegetation array not only incorporating wetland plants living in the rock-holes but also numerous Eremophila and Acacia species which provided important sources of bush medicines, bush tucker and material for tools, implements and artefacts. Overall, most rock-holes were assessed as being in good condition with goat grazing being the main threat at some sites. The assessment found that sheep on the pastoral leases rarely use the rock-holes due to alternative stock watering points, but at some sites they may still use the rock-water and degrade the area. Two sites were identified as having the highest ecological priority for management and future investments, these sites are also very significant to the Aboriginal people. The sites were Pilleutta on Kokatha Station; an Aboriginal women's site that was rich in bush tucker and medicine, and was in very good condition but is threatened by goat grazing. The other site was Bulpara Hill on Wilgena Station; an Aboriginal men's site that had a large diversity of shrub species with minimal population replacement observed. The main threats to the site were grazing to seedlings and shrubs by rabbits, goats and sheep.

The project succeeded in achieving its main objective of enhancing the knowledge and understanding of the cultural, ecological and pastoral value of rock-holes, it has raised awareness to allow for protection and management of culturally significant rock-holes, it has increased stakeholder engagement in rock-hole management, and

it has identified and documented the specific principles or protocols for engaging the Aboriginal community in such projects.

To build upon these components the SAAL NRM Board, South Australian Native Title Services and scientists from the Department for Water are aiming to continue working with the pastoral and Aboriginal communities to integrate management of land, water and cultural practices into the future.

INTRODUCTION

The South Australian Arid Lands Natural Resources Management (SAAL NRM) Board was funded through the Australian Governments Caring for our Country 2009/10 Program to undertake a project linking the cultural and ecological understanding of rock-holes in the Gawler Ranges of South Australia. This project was delivered through a partnership between the SAAL NRM Board, the Gawler Ranges native title claim group, the South Australian Native Title Services Ltd (SANTS), and the Department for Water (DFW) of the State Government.

Project Area

The Gawler Ranges are located to the north of the Eyre Peninsula in South Australia and consist of volcanic rock hills over 1500 million years old. These rocky hills and gullies contain water sources with some large and deep rock-holes persisting for many months. The climate of the Gawler Ranges is mild to hot in summer and cool to cold in winter with unreliable rainfall and a high evaporation rate throughout the year. Average annual rainfall across the region varies from 300 mm in the south (Gawler Ranges National Park) to less than 200 mm in the north (Tarcoola). Within the project area there are 30 pastoral leases and two major salt lakes systems, one of which is Lake Gairdner National Park. Prominent vegetation communities of the Gawler Ranges include *Casuarina pauper* (black oak) and *Acacia papyrocarpa* (western myall) low open woodlands, open mallee scrub, bluebush/saltbush open chenopod shrublands and *Acacia aneura* (mulga) shrublands. The principal land use is sheep grazing on native pastures.

Project Activities

The project was first initiated in 2008 and undertook a field trip to Wilgena and North Well pastoral leases and visited three sites (Meelera, Micklebar and Bulpara Hill). Harding and Blesing (2008) and White (2008) documented the cultural and ecological information resulting from this initial piece of work.

In 2009 further field trips were undertaken and another annual report was produced by Jenkin et al (2009) which documented the cultural information from the field trips and protocols for undertaking this type of work.

In 2010, while reporting on project activities and outcomes the project team has produced the following four reports for the SAAL NRM Board:

- The Overview Report: providing the background and context of the project including the cultural and ecological value of rock-holes;
- The Site Assessment Report: outlining and describing the site assessments undertaken during the project and allowing for future field assessments to be added to the report;
- The Management Plan: a cultural and ecological land management strategy for the Gawler Ranges native title claim group; and
- The Database Report: detailing the cultural and ecological database developed to store and manage data collected during project field work including rock-hole locations and cultural and ecological assessments.

The 2010 Overview and Site Assessment reports include information that has already been presented in previous annual project reports (White, 2009 and Jenkin et al, 2009). The information has been reproduced to deliver a series of collaborative reports that succinctly presents the information that this project collected from 2008 to 2010.

The Site Assessment Report is the focus of this report.

Background

A detailed description of the background and context of this project can be found in the 2010 Overview Report (Jenkin et al. 2011) with a brief summary taken from this report presented below.

Rock-holes have a range of ecological, cultural and socio-economic values though scientifically, rock-holes have received only sparse and scattered attention in relation to their aquatic flora and fauna inhabitants. The scientific study of rock-holes in arid areas of Australia is still very limited and there have been no prior studies within the vicinity of the Gawler Ranges. The closest studied rock-holes are further south on the Eyre Peninsula, near Wudinna and Minnipa (Timms, 2006), and in the Northern Territory, near Papunya and Uluru (Bayly, 2001; Timms, 2006).

Water in the arid Australian landscape has played a significant role in Aboriginal settlement and occupation. Consequently, the knowledge and careful management of these resources has been and continues to be vital to Aboriginal occupation within these areas. Aboriginal law assigns direct responsibility to look after water sources, adhere to protocols and pass on knowledge through song and narrative. Certain water supplies have deep cultural and ceremonial significance and are often associated with Aboriginal law or *Tjukurrpa*. For Aboriginal people across Australia, granite outcrops where rock-holes exist not only provided a crucial water supply in the arid areas but also facilitated access to a wide range of resources such as

medicinally important plants, bush tucker, tool implements and hunting areas for animals that also used the rock-holes as a water source (Bindon, 1997). Further details on the dynamic relationship held by Aboriginal people with land and water can be found in the annual project report Jenkin *et al* (2009).

Edward John Eyre named the region as the Gawler Ranges in 1839. On his journey, Eyre procured water from rock-holes that had recently filled from rain but were fast evaporating. The European settlers in the Gawler Ranges recognised the value of the granite domes as water collection areas. This is evidenced by a number of ‘improvements’ with cemented stone walls around the base of granite domes and rock-holes to direct water run-off into a larger collection point to increase water storage at a site. Aboriginal people, explorers, Afghans and pastoralists all have a connection with and value rock-holes as landscape features important to their culture and heritage.

FIELD ASSESSMENT METHODS

Cultural Field Assessments

In delivering the project, SANTS and the project team (including DFW) utilised a range of methods. Primarily these centered on social research methods in the field, with on-country qualitative interviews and conversations being the principal means by which data was obtained. To assist in this process, question guides and data proformas were created. The guides covered a range of topics deemed critical by the project team to the delivery of project outcomes, specifically the identification of cultural values and aspirations for the management of each of the rock-holes visited.

Desktop research and analysis was also undertaken prior to, and following the field work. In addition, SANTS provided the project liaison with the region's pastoralists in order to share the project objectives, negotiate access to lease areas and seek to arrange times to meet and discuss ways forward for the project. During the field work, a range of mapping resources were used to locate rock-holes, including satellite imagery accessed via 'Google Earth' along with contemporary and historic maps of water resources and pastoral infrastructure using Geographic Information System (GIS). Rock-holes were then located in the field through bringing together the knowledge of Aboriginal participants, pastoralists and the variety of mapping resources. Nevertheless, locating rock-holes was still a challenging task due to their small size and often significant time was spent searching by both vehicle and on foot.

During the field trips, cultural assessments of each rock-hole were undertaken in collaboration with Aboriginal participants to record and document the Aboriginal cultural values, perspectives and aspirations for the rock-holes. All of the rock-holes visited during the fieldtrips are of cultural significance to members of the Gawler Ranges native title claim group. The rock-holes are integral parts of the cultural landscape, being key mythological sites and elements of Aboriginal law or *Tjukurrpa*. Many of the rock-holes are connected through song, story and ceremonial lines which cross and form this landscape. Knowledge of these places has been passed down through generation after generation in accordance with Aboriginal law and custom. The significance of these places is such that specific cultural protocols need to be followed, including at times in relation to gender and also in regard to undertaking specific cultural actions to ensure safe approach to the rock-holes. These protocols were followed in approaching rock-holes during field work under the

guidance of senior Aboriginal men and women. While recording the cultural values of rock-holes is an objective of this project, it is important to note that this report does not document cultural information which is sensitive and/or restricted in accordance with Aboriginal law and custom and the wishes of members of the Gawler Ranges native title claim group.

While some cultural information is not able to be presented in this report, the Gawler Ranges native title claim group has established a Cultural and Ecological Information Management System (CEIMS) to store and manage any such information. The database was established with support of SAAL NRM Board as part of the 2009/10 rock-hole project with the assistance of traditional owners to:

- Centralise existing cultural and ecological data relating to the project
- Provide methods for capturing important cultural information gathered during fieldtrips
- Provide methods for organising and transferring existing data into the system
- Provide a means to transfer selected data to other government databases developed for the region
- Consider data sensitivities, access and protection protocols as defined by Aboriginal community user groups, SA Native Title Services and SA Arid Lands NRM Board
- Provide the means to store various data entry forms and data types as determined from initial workshops/consultations
- Provide the ability to restrict access to user groups based upon feedback received from consultation with various stakeholders

Further details of the database are outlined in the fourth report of this reporting series (Environmental Systems Solutions, 2010).

Ecological Field Assessments

The aquatic ecology team in the Department for Water have been undertaking rapid vegetation assessments of springs, waterholes and rock-holes in the SAAL NRM Board region since 2008 (White and Scholz, 2008; Scholz and Deane 2011; McNeil et al, 2011). Specifically, this report adds to previous information collected at rock-holes in the Gawler Ranges (White, 2009 and Jenkin et al, 2009).

Conceptual understanding of rock-holes in the Gawler Ranges

The previous report on rock-holes in the Gawler Ranges undertook a review of current scientific knowledge on rock-holes to formulate a background and conceptual understanding of rock-hole function across the landscape (White, 2008). This report will only provide a summary of the 2008 review.

Rock-holes have been grouped into two basic forms as pits and pans (Bayly, 1999). These are described as:

- Pit-gnammas are typically hemispherical in shape and sub-circular in outline with a large depth to surface area ratio and often contain water for extended monthly periods (Figure 1).
- Pan-gnammas have flat floors and sloping sidewalls with a small depth to surface area ratio and often contain water for a limited time of weeks rather than months (Figure 1). Pan-gnammas are highly irregular in outline and it is common for one pan-gnamma to grow into another.

Both types of rock-hole occur on the upper surfaces of inselbergs where the inclination is less than 20 degrees (Bayly, 1999) indicating a threshold for rock-hole formation.

Other types of rock-holes that the field team has come across in the Gawler Ranges include:

- Apron, the descending edge of an outcrop (Main, 1997), where pools had formed (Figure 1).
- Headwater, a confined valley bedrock setting where there is no floodplain but where a steep creek line exists with waterfalls and cascades (Brierley and Fryirs, 2002), where pools had formed (Figure 2).

Figure 1. An example of a pit rock-hole (right), a pan rock-hole (bottom left) and an apron pool (top left) in the Gawler Ranges.

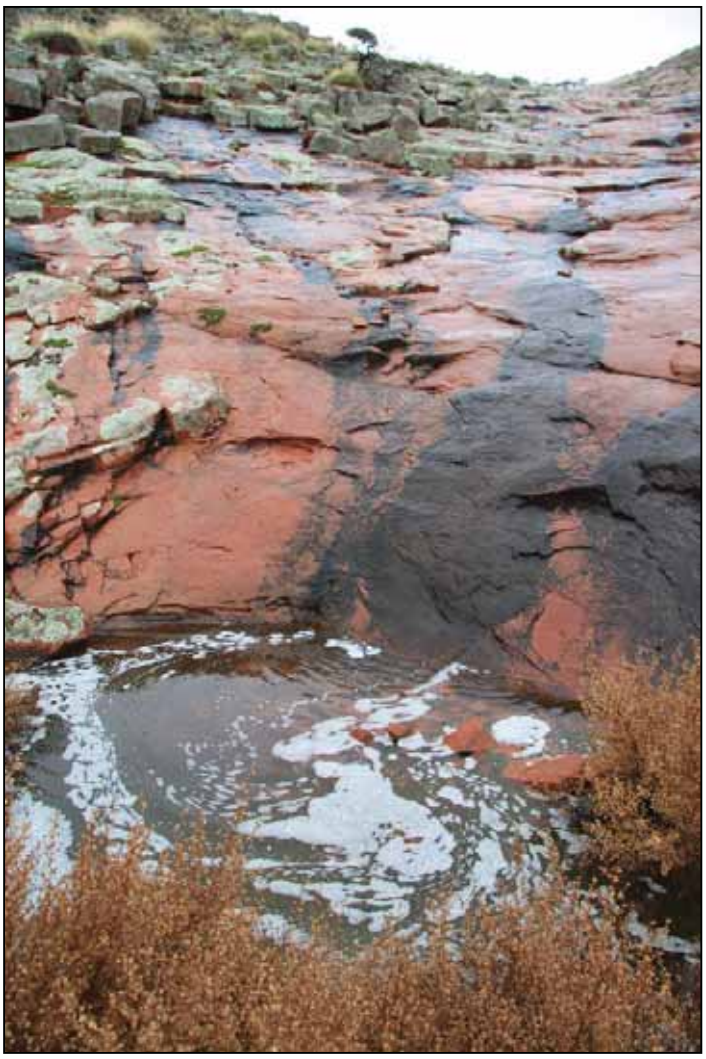

Figure 2. An example of a headwater pool within the Gawler Ranges that were assessed as part of this project.

Aboriginal people, early white explorers (Harvey Johnston, 1941; Bindon, 1997) and scientists (Bayly 1999, Pinder 2000, Bayly, 2001; Timms, 2006) concur that rock-holes are filled by localised rainfall events, whereby local run-off on the rock-face funnels water into the holes and depressions. The duration of water in the rock-holes is dependent upon a number of factors including; rainfall frequency/season, run-off area, evaporation rate, aspect, size, depth of the hole and if any animals are using the water for drinking.

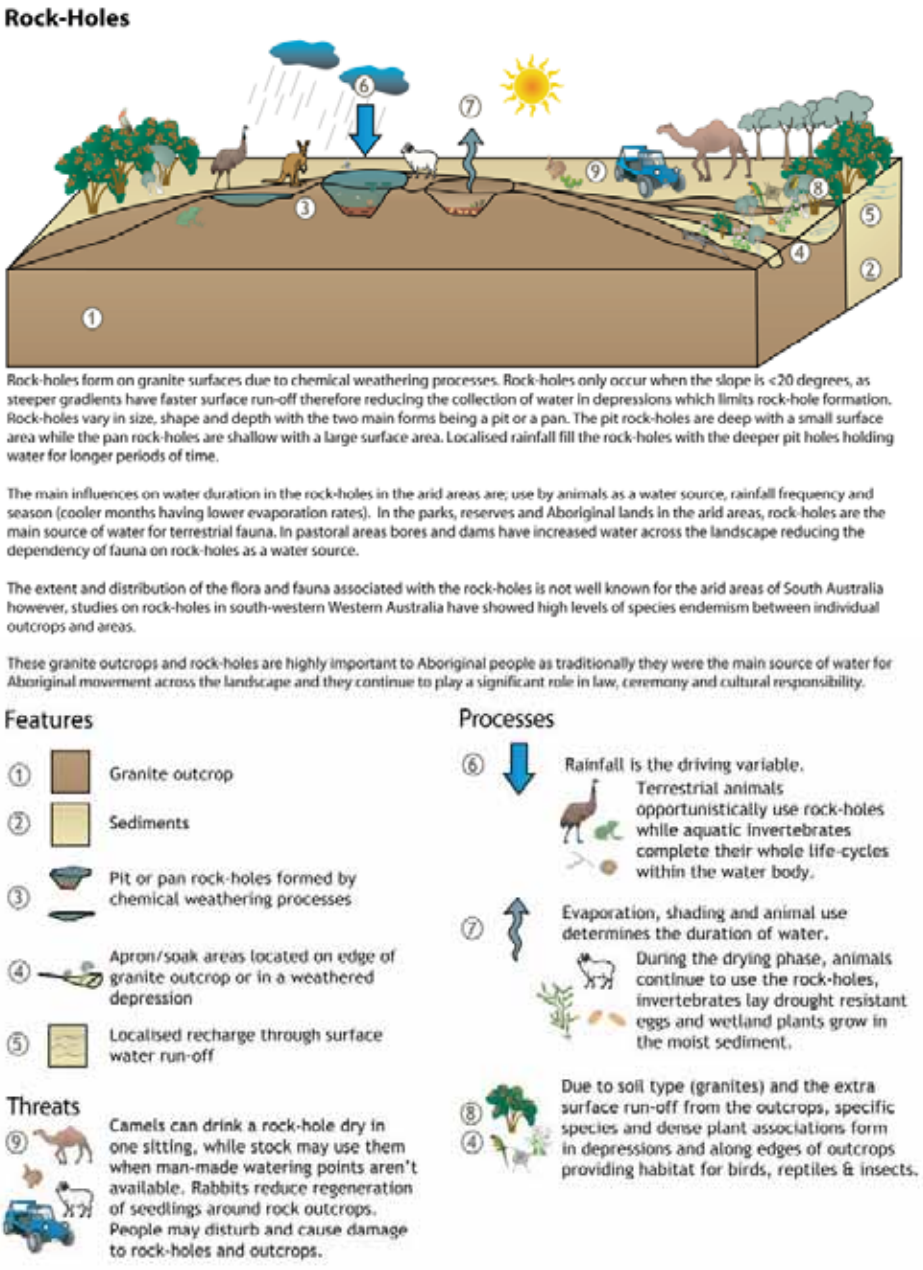

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Figure 3. The conceptual diagram that this project developed on rock-hole form and function within the landscape.

Rapid vegetation assessment

Within this report each rock-hole has an individual assessment sheet which is broken into four sections/pages:

1. Describes the cultural site information and plant species.
2. Describes the ecosystem values and threats information.
3. Describes the condition assessment values.
4. Summarises the assessment information into a site restoration potential, investment priority and joint (cultural and ecological) management considerations.

The keys and tables used in the site assessments are repeated throughout the report so each site can have information available as a 'stand-alone' assessment that can be used for future surveys, reporting or uploading into the database. Each site has not been given an overall score or rating, as it is intended that future monitoring and management will use cultural information aligned with traditional ecological knowledge in hand with current site condition to determine investment. For this to occur it is best that the ecological information for each category is transparent and all information is used to make a decision rather than a final score.

A description of the information within each of the four categories that each rock-hole is assessed against is provided below.

1: Site Information

A summary of the cultural assessment provides the mythological and archaeological values of the site (see previous section on Cultural Field Assessment for more information).

A species list is provided from a qualitative rapid assessment. Perennial species are the main focus of the surveys to determine grazing impacts (McDonald, 2005). Annual species are not used to determine the condition rating of a site because they a influenced by seasonal conditions. Annual weed species are included as a component in the assessment of condition rating. Foliage cover of the three most dominant species at each site are numbered (^{1,2,3}) in the species list, along with the Aboriginal plant names and uses.

2: Ecosystem Values and Threats

This section comprises two tables, the first table details information about the site which is filled in using a key, the second table is the key itself with an example of the key provided below (Key 1). The key describes the various values which can be

assigned to an indicator. Currently values are by necessity assigned on a relative scale as more information is needed to correctly assign each attribute a value based on more quantitative criteria. Gaps in the table are purposely used, to allow simple descriptions of an attribute. The attributes and values within the table have been developed to help identify key aquatic refuge and aquatic ecosystems within the landscape.

Key 1. Key to ecosystem values used within the ecological site assessment and evaluation form for each site. The rating system for attributes are; Green = high; Blue = moderate -high; Purple = moderate; Orange = low – moderate; Red = low.

ECOSYSTEM VALUES							THREATS				
1 Plant diversity	2 Habitat diversity	3 Hydrological value	4 Salinity	5 Cultural site	6 Uniqueness	7 Key aquatic refuge	8 Weeds	9 Exotic Animals	10 Water abstraction	11 Grazing Pressure	12 Dung/dead matter/algal build-up
1 sp. for each strata (incl. aquatic)	≥ 3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site e.g. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

The supporting information behind the coloured ranking system for each of the 12 attributes that each rock-hole is assessed against is as follows:

1. Plant Diversity; a condition indicator of rangeland ecosystems is species composition of understorey (grasses/forbs), mid-storey (shrubs) and canopy (trees) (McDonald, 2005). We have added a further ranking of aquatic plants as these are known to occur within rock-holes though sparsely at a spatial scale. For this reason aquatic plants are not a 'strata' but are an additional value to a site and are ranked accordingly so.
2. Habitat Diversity; we have based our geomorphic habitat valuation on the River Styles method (Brierley et al, 2002). With rock-holes being relative simple geomorphic systems of pits and pans (see previous section) we have added an additional value for when more than two types exist.

3. Hydrological Value; permanent water within rangeland/arid ecosystems are important refuge areas for aquatic species and have therefore been given a high rank. Rock-holes are considered ephemeral filling by seasonal and episodic rainfall though some may hold water 'permanently' in-between refill events.
4. Salinity; this ranking has been based on aquatic ecosystems salinity thresholds as published in Appendix A of White and Scholz (2008).
5. Cultural Site; the ranking is based on the sites within a natural park or of heritage significance having a higher value than a site that is only a watering point and therefore has grazing impacts (piosphere) (Ehmann, 2005).
6. Uniqueness; this valuation is determined by the number of rock-holes that exist. The less there are the more important it is for supporting the ecosystem during drought periods.
7. Key Aquatic Refuge; the ecological value using national listings are given a higher ranking.
8. – 10. Threats; the absence of weeds, feral animals and water being abstracted from the site are given a higher rank.

11. – 12. Threats; if grazing pressure and dung/dead matter/algal build-up are deemed to be 'low' it is given a higher rank. The response of rangeland vegetation to grazing is widely recognised (Cunningham et al, 1992; Kutsche and Lay, 2003) and is used as a condition indicator in pastoral lease assessments in South Australia (McDonald, 2005, Gould et al, 2001).

3: Site Condition

The Aquatic Ecosystems Task Group (AETG) formed the River Health Contact Group (RHCG) in May 2007 to provide advice on river health indicators for the National NRM Monitoring and Evaluation Framework. The RHCG was tasked with developing a nationally agreed methodology for assessing riparian vegetation condition. A major hurdle in developing a common methodology for a vegetation condition theme is that there are many methodologies available across Australia based on varying purposes and outcomes with a high degree of methodology turnover and evolution. Consensus on agreeing to a single vegetation condition assessment methodology that could achieve everyone's desired outcomes was considered a near impossible task. With regards to this issue the RHCG determined that it was the interpretation of the data for management that was of more

significance than the specific methodology used to collect the data. The approach adopted was to design a framework based on the common elements of existing methods that would provide a consistent evaluation of vegetation condition. To be useful as an ongoing NRM tool the framework would need to potentially be able to accommodate data from a range of older methods as well as adapt to emerging methods and future developments. Roberts et al, (2009) developed the draft Riverine (Riparian) Condition protocol for the RHCG. This project has adopted the framework (protocol) to assess the condition of rock-holes, the description of the attributes (Key 2) and the table (Key 3) developed by Roberts et al (2009) which was used for this assessment are presented below.

Key 2.The attributes developed by Roberts et al (2009) that was used for this assessment.

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Key 3.The method developed by Roberts et al (2009) that was used for this assessment and evaluation.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (e.g. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (e.g. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

4: Current Management, Restoration Potential and Investment Priority

Section 4 of the assessment sheet summarises the information described in Sections 1-3 and provides a summary of the current management practices, restoration

potential and the ecological and cultural investment priority of the rock-hole. The methodology behind the investment priority and restoration potential are further described below.

Restoration Potential:

Rangeland attributes of resistance (withstand disturbance) and resilience (recover from disturbance) was used to determine its restoration potential. A heavily disturbed site will have a low score, with a less disturbed or recovering site having a higher score. Those sites that are under good management and show resistance to disturbance are scored as intact.

Investment Priority:

Ecological prioritisation for investment was weighted towards those rock-holes that have the greatest contribution as a diverse habitat as well as those that have the greatest recoverability potential in relation to management investment and intervention. This means that those rock-holes that are significantly ecologically impaired may have a lower priority for investment due to a low recovery potential. Those that are ecologically intact may also have a lower priority for additional investment due to their relative security under current environmental conditions and management regimes.

All rock-hole sites are culturally significant to Aboriginal people. Those rock-holes culturally significant and require further traditional management have been identified as a higher priority; those sites that do not require management have been prioritised as intact ecosystems.

FIELD ASSESSMENTS

During an 18-month period, the project has visited 21 sites and assessed 18 of these sites across seven pastoral leases in the Gawler Ranges (Figure 3). Site selection for assessments was based on whether a rock-hole or water source was present at the site and vehicle accessibility. Vehicle accessibility was an important factor during field work as it was vital for Aboriginal elders to be able to visit the sites.This section details the cultural and ecological site assessments for each of the sites on the pastoral leases.

Assessments have been undertaken at the following pastoral leases:

2009

- Wilgena; three rock-holes and one clay-pan.
- North Well; two rock-holes and one soak on a salt lake edge.
- Kokatha; one rock-hole site.

2010

- Moonaree; two rock-hole sites.
- Koweridda; one rock-hole site.
- Thurlga; one rock-hole and three headwater pools.
- Yardea; one rock-hole and two headwater pools.

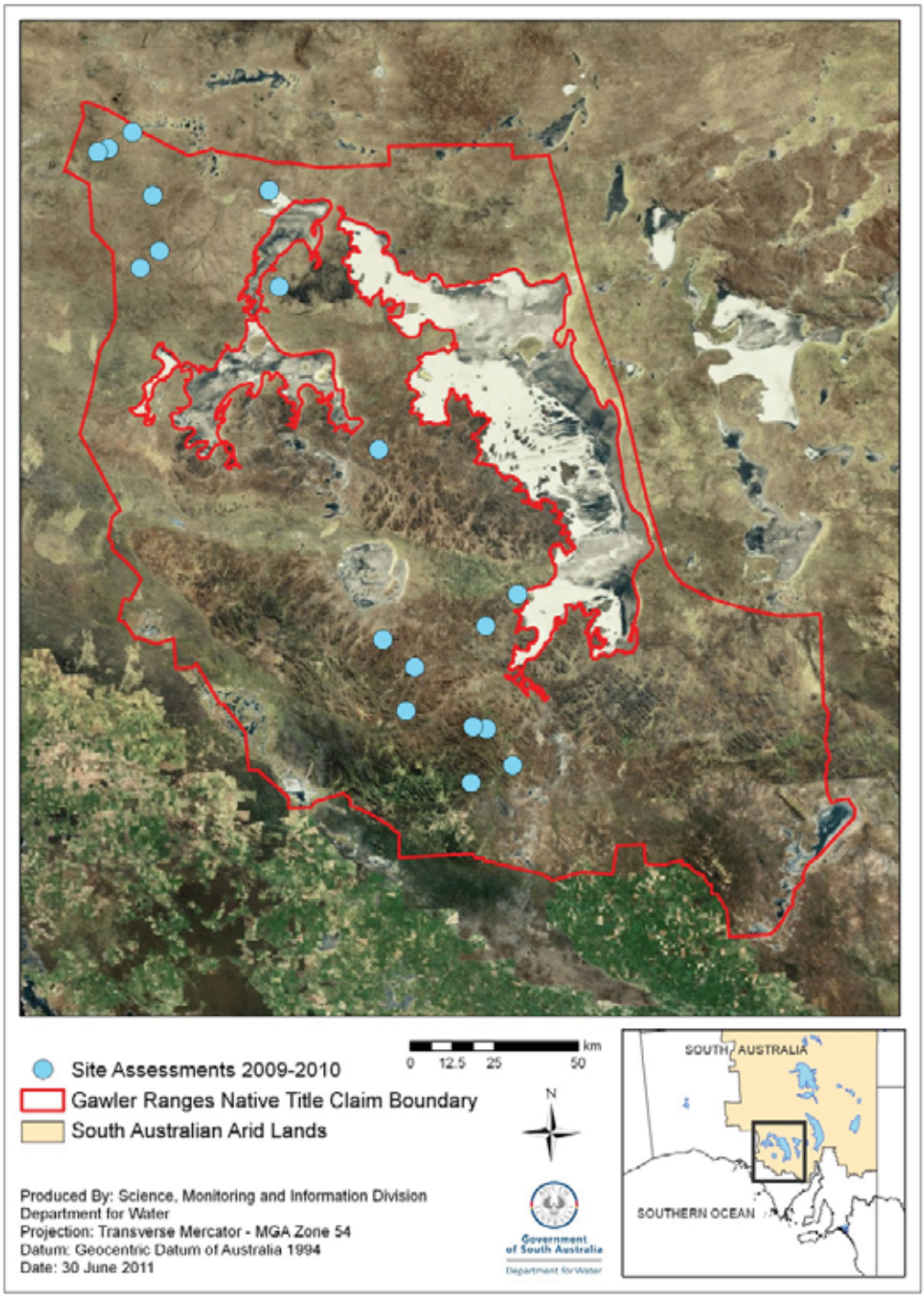


Figure 3. The 18 sites assessed in the Gawler Ranges during field trips in 2009 and 2010.

WILGENA

Four sites were visited in June 2009 on the Wilgena pastoral lease which consisted of; three granite outcrops that contained rock-holes (Mullina, Darebin and Bulpara) and one clay pan that contained water while looking for a rock-hole site at Moolkra.

The following cultural and ecological information presented in this report was collected in June 2009 at Wilgena Station.

Figure 4. Participants on reconnaissance field trip to Wilgena and Kokatha Stations, April 2009 (Back from left: Francis, Fred Smith, Don Blesing, Samantha Muller, Rod Lucas, Brandon McNamara Snr; Front from left: Bob Starkey, Tony Smith, Lynette Ackland.

Bulpara Hill

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Bulpara Hill	Restricted (Male)	Wilgena	11th June 2009

Site Description	Bulpara Hill
Feature	Granite ridge with rock outcrops and numerous rock-holes (pits and pans), a dam-like feature also exists at the site.
Size / Area	The ridge is ~600 m long with surveyed rock-holes along a 200 m section of the ridge.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~220 m
Vegetation association	Surrounding slope was an *Acacia aneura* (Mulga) low open woodland. The hill slope was an *Acacia tarculensis* (Tarcoola Wattle) woodland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Local knowledge of area needed.	Yes	Good	Hard

Figure 5. The sandy slopes surrounding Bulpara Hill were dominated by *Acacia aneura* (Mulga).

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Closed	Male	High	Registered
Archaeological	Observations			
	Scatters Camp fire	Historical Burial Site		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	*Limosella granitica*	Granite Mudwort	-	-
	Marsilea drummondii	Nardoo	-	Seeds
Grasses / forbs	*Centipeda thespidioides*	Desert Sneezeweed	Kata-palkalpa (P)	Narcotic, medicine
	Cheilanthes lasiophylla	Woolly Cloak Fern	-	-
	Ptilotus obovatus	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Sida corrugata	Corrugate Sida	-	-
	Solanum sp.	-	-	-
	Sporobolus actinocladus	Fairy Grass	-	-
Shrubs	[1,2]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Dodonaea lobulata	Lob-leaf Hopbush	-	-
	Eremophila sp.	-	-	-
	Enchylaena tomentosa	Ruby Saltbush	Iwatiwata (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Rhagodia parabolica	Mealy Saltbush	-	-
	Senna artemisioides	Silver Cassia	Karpil-karpilpa (P) Arapita (P) Inuntji (P) (fresh growth & flowers) Pilani (P) Punti (P) Untunu (P)	Medicine (leaves are boiled and are put into a cream for aches and pains) (K) Grubs
Trees	[3]*Acacia aneura*	Mulga	Kalpilya (P)	Seeds, Artefacts, tools

			Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	
	Alectryon oleifolius	Bullock Bush	Tjalura (P)	?Buds
	Casuarina pauper	Black Oak	-	-
	Hakea sp.	-	-	-
	Santalum acuminatum	Quandong	Kuuturu (P) Mangata (P) (Y) Wayanu (P) (Y) Witirrpa (seed) (P)	Fruit

* indicates exotic species. 1,2,3 indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	HIGH	Aquatic: 2 species Understory: 6 species Shrub: 6 species Canopy: 5 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	HIGH	Shallow pool / pans: numerous pans Deep pools / pits: 2 pits Apron pool (at granite outcrops): 1 apron pool / dam	Number and size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but was assumed that the water was fresh from recent rainfall.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	A number of rock-holes exist on granite outcrop	Qualitative Survey
7	**Key aquatic refuge**	MODERATE - HIGH	*Limosella granitica* (Granite Mudwort) is listed as a vulnerable species (DEH West Region, 2007). A large shrimp-like invertebrate was observed in the apron pool / dam.	Qualitative Survey (sample not verified)
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	PRESENT	Evidence of significant numbers of rabbits at the site. Evidence of goats was also observed.	Qualitative Survey
10	**Water abstraction**	HISTORIC	Dam embankment suggests that the site may have historically been an important watering point.	Local Knowledge
11	**Grazing pressure**	MODERATE - HIGH	Overall there was evidence of significant grazing impact at the site. Most of the ground cover species were absent. Grazing impact was observed from sheep, rabbits and goats. From discussions with the landholder sheep tend to get trapped around this site when water is available in the pools concentrating stock around the rock-hole site. A significant number of dead sheep were observed.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	MODERATE	Sheep dung, algae and sediment was observed in the rock-holes.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No evidence of large scale vegetation loss at site	Observation
Nativeness	LARGELY UNMODIFIED	No perennial weeds were recorded at the site.	Observation
Structural Integrity	SLIGHTLY MODIFIED	Grazing has impacted the sub-shrub / groundcover layer.	Observation
Age Structure	SLIGHTLY MODIFIED	The dominant shrub layer *Acacia tarculensis* (Tarcoola Wattle) showed signs of grazing with no juveniles present.	Observation
Debris	SLIGHTLY MODIFIED	Debris is reduced due to grazing and stock trampling.	Observation

Table 4: Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

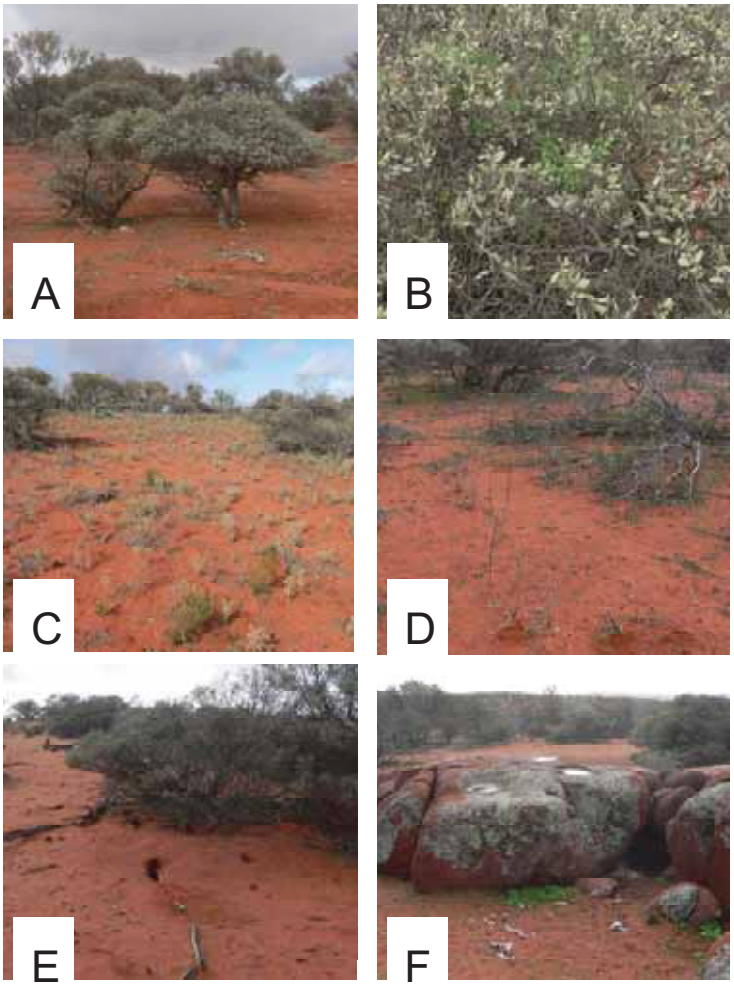
Rabbit and sheep grazing have had a significant impact at the site. Browse lines are evident on the shrub layer (Tarcoola wattle and Bullock Bush) (Photo A), with many shrub species (Climbing Rhagodia and Ruby saltbush) only growing when protected amongst other shrubs (Photo B).

There is a large cover of *Solanum sp* which is an increaser ground cover species in heavily grazed areas (Photo C).

Many juvenile trees and shrubs were heavily grazed (Photo D).

In the sand-plains area significant rabbit activity / impact was observed (Photo E).

From discussions with the landholder sheep tend to get trapped around this site when water is available in the pools concentrating stock around the site. A significant number of dead sheep were observed at the site (Photo F).



Restoration Potential:

HIGH: The combination of both diversity of species at the site and a good cover of adult plants will naturally provide a seed source for recruitment, especially if rabbit and goat control are incorporated into the management of the site.

Ecological Investment Priority:

HIGH: The site had a large diversity of different shrub species with minimal population replacement observed. The main threats to the site are grazing by goats, rabbits and sheep; with sheep and goats preferentially browsing the shrubs, while rabbits may be impacting seedling growth.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 6. Ants nest, with seed husks surrounding the nest opening

Darebin

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Darebin	Restricted (Male)	Wilgena	11th June 2009

Site Description	Darebin
Feature	Granite outcrop containing numerous pit and pan rock-holes and one apron pool/dam like feature on the edge of the outcrop.
Size / Area	Granite outcrop ~300 m long.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~170 m
Vegetation association	Open woodland of mixed Acacia species.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Local knowledge of area needed.	Yes	Bad	Hard

Figure 7. Surrounding open woodland association of Acacia species at Darebin

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Closed	Male	High	Unrecorded
Archaeological	Observations			
	Scatters Camp fire	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	[3]*Aristida nitidula*	-	-	-
	Euphorbia tannensis ssp.	Desert Spurge	Ipi-ipi (P)	Decoration, medicine
	Ptilotus obovatus	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Sida corrugata	Corrugate Sida	-	-
Shrubs	[1,2]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Enchylaena tomentosa	Ruby Saltbush	Iwatiwata (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Eremophila sp.	-	-	-
Trees	*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools
	Casuarina pauper	Black Oak	-	-
	Eucalyptus sp.	Mallee sp.	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	Aquatic: 0 species Understory: 4 species Shrub: 3 species Canopy: 3 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	Deep pool / pit: 2 pits Shallow pool / pans: numerous pans Apron pool (at granite outcrops): 1 apron pool	Number and size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	A number of rock-holes exist on granite outcrop	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Aquatic invertebrates were observed.	Assumption
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	LOW	The paddock was mostly unstocked (need confirmation) so grazing did not appear on shrubs or forbs, but close grazing on grasses. Overall grazing impact at the site was low although dung was present in the rock-holes, possibly goat/rabbit.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	None observed.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Connection of rock outcrop flora with surrounding landscape	Observation
Nativeness	LARGELY UNMODIFIED	No high impact weed species were observed at the site.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum, with the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	Dominant strata are the understory strata, due to low grazing natural cover and recruitment were observed.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4: Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

The paddock that Darebin rock-holes are located in was unstocked at time of survey. There was minimal evidence of grazing on shrubs, with some close grazing on grasses.

Restoration Potential:

INTACT: Ensure that current land management practices are maintained.

Ecological Investment Priority:

INTACT: This rock-hole site is in good condition with minimal threats noted.

Cultural Investment Priority:

INTACT: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

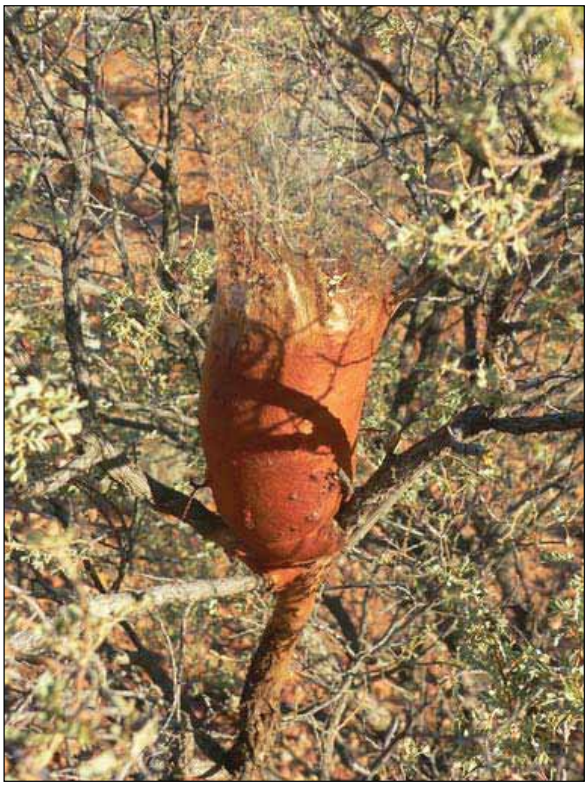


Figure 8. Itchy caterpillar nest (most likely to be Processionary Caterpillars that eventually become moths called Bag-shelter Moths, *Ochrogaster lunifer*), the nest is used as a bush-medicine for the treatment of burns.

Moolkra

Feature	Name	Cultural access	Lease	Date visited
Clay-pan / Kapi tjintjira	Moolkra	Open	Wilgena	11th June 2009

Site Description	Moolkra
Feature	Clay-pan
Size / Area	~25 m x 15 m
Conceptual understanding	Clay-pans fill with seasonal and episodic rainfall
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~130 m
Vegetation association	Surrounding plain was a chenopod shrub-land of *Atriplex vesicaria* (Bladder Saltbush) and *Maireana pyramidata* (Black Bluebush).

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Track through paddock following fence.	Yes	Average	Easy

Figure 9. Moolkra clay-pan with a chenopod shrub-land vegetation association, dominated by *Maireana pyramidata* (Black Bluebush).

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	Medium	Unrecorded
Archaeological	Observations			
	Scatters			

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	-	-	-	-
Shrubs	*Atriplex vesicaria*	Bladder Saltbush	Iriya (P) (Y)	-
	[3]*Chenopodium nitrariaceum*	Nitre Bush	-	-
	[1,2]*Maireana pyramidata*	Black Bluebush	-	-
Trees	-	-	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	LOW	Aquatic: 0 species Understory: 0 species Shrub: 3 species Canopy: 0 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	LOW	Shallow pool / pans: clay-pan	High
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but clay-pans fill with local rainfall and as they dry down they become more saline (based upon the occurrence of samphire and salt on the soil surface). Due to recent rainfall, the water was assumed to be fresh.	Assumption
5	**Cultural site**	LOW	Clay-pans would have been used opportunistically by Aboriginal people moving across country.	
6	**Uniqueness**	LOW	Numerous clay-pans occur in the area	Local Knowledge
7	**Key aquatic refuge**	LOW - MODERATE	A survey was not undertaken, but it is assumed that aquatic invertebrates would occur at the site, esp. shrimp.	Assumption
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	HIGH	Heavily grazed as vegetation association of *Maireana sedifolia* (Pearl Bluebush), *Atriplex vesicaria* (Bladder Saltbush), has been replaced with *Maireana pyramidata* (Black Bluebush). The clay-pan is located near a fence-line and is near to a large watering area; so the site has deep sheep pads from heavy stock trampling.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	None observed.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	MODERATELY MODIFIED	The chenopod shrubland is reduced by ~1/3 at the site.	Observation
Nativeness	LARGELY UNMODIFIED	No perennial weeds were recorded at the site.	Observation
Structural Integrity	MODERATELY MODIFIED	Grazing has impacted the shrub layer (perennial salt bushes) at the site. It appears that current grazing is limiting regeneration at the site.	Observation
Age Structure	SLIGHTLY MODIFIED	Reduced cover of shrub layer and two age class were determined to be present on the northern side.	Observation
Debris	MODERATELY MODIFIED	The clay-pan is located near a fence-line and is near to a large watering area; so the site has deep sheep pads from heavy stock trampling.	Observation

Table 4: Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Due to grazing impacts, saltbush recruitment is limited.

Restoration Potential:

LOW: The degraded state of the soil type at this site is difficult to rehabilitate given the sand topsoil has mostly been removed due to stock trampling and grazing, and the clay subsurface soil is now exposed.

Ecological Investment Priority:

LOW: This type of surface water feature is not a priority.

Cultural Investment Priority:

LOW: This type of surface water feature is not a priority.

Figure 10. A clay-pan within the vicinity of Moolkra Rock-hole, Moolkra rock-hole was not visited during this trip.

Mullina

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Mullina	Open	Wilgena	12th June 2009

Site Description	Mullina
Feature	Granite outcrop containing numerous pit and pan rock-holes.
Size / Area	The outcrop was spread over ~600 m.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~170 m
Vegetation association	The canopy was dominated by *Acacia tarculensis* (Tarcoola Wattle) and *Acacia aneura* (Mulga), with the understorey dominated by *Eragrostis eriopoda* (Woollybutt) and *Ptilotus obovatus* (Silver Mulla Mulla).

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Fence track near-by but no direct track to granite outcrop.	No	Good fence track	Difficult – hard

Figure 11. Mullina granite outcrop with numerous pan rock-holes full of water, with Tarcoola Wattle on the edge.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Unrecorded
Archaeological	Observations			
	Scatters Historical	Stone Arrangements		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	*Limosella granitica*	Granite Mudwort	-	-
Grasses / forbs	*Aristida nitidula*	-	-	-
	Cheilanthes lasiophylla	Woolly Cloak Fern	-	-
	Enneapogon sp.	-	-	-
	[2]*Eragrostis eriopoda*	Woollybutt	Ngutjanu (P) Wangunu (P) (Y)	Seeds
	Erodium cygnorum	-	Malu-munpunpa (P) Malu-pumpunya (P)	Seeds
	Ptilotus obovatus	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
Shrubs	*Solanum petrophilum*	Rock-Nightshade	Tjilka-tjilka (P) (Y)	Poisonous
	Wurmbea sp.	-	Jungul-jungul (K)	Roots
	[1]*Acacia tarculensis*			
	Acacia tetragonophylla	Dead Finish	Kurara (P) (Y) Kurungantiri (P) Wakalpuka (P)	Seeds
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Eremophila rotundifolia	Round-leaf Emubush	Aratja (P)	
	Lysiana exocarpi	Mistletoe	Parka-parka (P) (Y) Ngantja (P) (Y) Warilyu (P)	Fruit
	Senna artemisioides	Silver Cassia	Karpil-karpilpa (P) Arapita (P) Inuntji (P) (fresh growth & flowers)	Medicine (leaves are boiled and are put into a cream for aches and

			Pilani (P) Punti (P) Untunu (P)	pains) (K) Grubs
Trees	[3]*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	HIGH	Aquatic: 1 species Understorey:8 species Shrub: 6 species Canopy: 1 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	Deep pool / pit: ~ 10 pits Shallow pool / pans: ~ 45	Size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	A number of rock-holes exist on granite outcrop	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Aquatic invertebrates were observed.	Qualitative Survey
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	PRESENT	Evidence of goat and rabbit presence. Evidence of low stock numbers (recovery and regeneration of Acacia species)	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	LOW	Evidence of low stock numbers (recovery and regeneration of Acacia species	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	Some sediment and animal dung.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Vegetation on granite outcrop and surrounding area is intact. No evidence of vegetation loss.	Observation
Nativeness	LARGELY UNMODIFIED	No perennial weeds were recorded at the site.	Observation
Structural Integrity	LARGELY UNMODIFIED	All strata present and good coverage of *Eragrostis eriopoda* (Woollybutt) in surrounding area.	Observation
Age Structure	LARGELY UNMODIFIED	Previous grazing of Tarcoola Wattle had recovered , regeneration present and sub-adults of Mulga present	Observation
Debris	LARGELY UNMODIFIED	Debris present	Observation

Table 4: Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

From speaking with the Land Manager the paddock is rarely grazed though there is evidence of goats and rabbits at the Mullina rock-holes.

Photo A: Regrowth of previously heavily grazed *Acacia tarculensis* (Tarcoola Wattle). Note browse line at shoulder height and regeneration from tree base.

Photo B: Historical regeneration *Acacia aneura* (Mulga), age unknown but Mulga growth rates are very slow.

Photo C: Good coverage of *Eragrostis eriopoda* (Woollybutt) understory grass species.

Photo D: Grazed *Eremophila alternifolia,* goats readily graze this species.

Restoration Potential:

INTACT: Due to plant diversity of site and the current ungrazed regime, regeneration is already occurring eg. Tarcoola Wattle and Mulga.

Ecological Investment Priority:

INTACT: This rock-hole is in good condition with minimal threats noted; land management practices should be maintained.

Cultural Investment Priority:

INTACT: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 12. Moist sedimented pan rock-hole with a mixture of *Limosella granitica* (Mudwort, Liverworts & Crassula's)

NORTH WELL

Three sites were visited in June 2009 on the North Well pastoral lease which consisted of; two granite outcrops that contained rock-holes (Arcoordaby and Tunkillia) and one soak on the edge of a salt lake (Tomato Camp).

Two rock-hole sites were also visited in 2008 but were not assessed (Meelera and Micklebar), the group would like to visit these sites again to properly assess them.

The following cultural and ecological information presented in this report was collected in June 2009 at North Well.

Figure 13. Tunkilla Rock-hole which comprises of a series of pan rock-holes.

Arcoordaby

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Arcoordaby	Restricted (Male)	North Well	15th June 2009

Site Description	Arcoordaby
Feature	Granite outcrop containing numerous pan rock-holes and one apron pool on the edge of the outcrop.
Size / Area	Two outcrops spread over ~1.5km
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~180 m
Vegetation association	Surrounding plain was a chenopod shrub-land of *Atriplex vesicaria* (Bladder Saltbush), *Maireana sedifolia* (Pearl Bluebush), *Maireana pyramidata* (Black Bluebush) and *Maireana astrotricha* (Southern Bluebush)

Vehicle track description	Track Yes/No	Track condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Two wheel tracks, hard access to rock, local knowledge of area needed.	Yes	Average	Hard

Figure 14. Photograph of the plain surrounding Arcoordaby being a chenopod shrub-land dominated by *Atriplex vesicaria* (Bladder Saltbush) and *Maireana pyramidata* (Black Bluebush).

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Closed	Male	High	-
Archaeological	Observations			
	Scatters Camp fire	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Ptilotus obovatus*	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
Shrubs	*Acacia tetragonophylla*	Dead Finish	Kurara (P) (Y) Kurungantiri (P) Wakalpuka (P)	Seeds
	[1]*Atriplex vesicaria*	Bladder Saltbush	Iriya (P) (Y)	-
	[3]*Maireana sedifolia*	Pearl Bluebush	-	-
	[2]*Maireana pyramidata*	Black Bluebush	-	-
	Maireana astrotricha	Southern Bluebush	-	-
	Rhagodia sp.	-	-	-
Trees	*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools
	Acacia sp.	-	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	Aquatic: 0 species Understory: 1 species Shrub: 6 species Canopy: 2 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	Shallow pool / pans: numerous pans Apron pool (at granite outcrops): 1 apron pool	Number and size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall. Some sediment in the rock-holes.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	A number of rock-holes exist on the granite outcrop	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	A survey was not undertaken, but it is assumed that aquatic invertebrates would occur at the site, as at other rock-holes.	Assumption
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	HIGH	Vegetation association of *Maireana sedifolia* (Pearl Bluebush) and *Atriplex vesicaria* (Bladder Saltbush) has been reduced and is dominated with *Maireana pyramidata* (Black Bluebush) due to historic grazing. The northern side of the site is the most degraded with most shrubs removed up to 300 m from the outcrop.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	None observed.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. Pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	SLIGHTLY MODIFIED	The northern side of the site is the most degraded with most shrubs removed up to 300 m from the outcrop. Overall, the chenopod shrubland is reduced by ~1/3 at the site.	Observation
Nativeness	LARGELY UNMODIFIED	No weeds were recorded at the site.	Observation
Structural Integrity	MODERATELY MODIFIED	Grazing has impacted the shrub layer (perennial saltbush) at the site. It appears that current grazing is limiting regeneration at the site.	Observation
Age Structure	SLIGHTLY MODIFIED	Reduced cover of shrub layer and two age class were determined to be present on the northern side.	Observation
Debris	MODERATELY MODIFIED	Debris at the site has been altered due to loss in cover of shrub layer.	Observation

Table 4: Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Stock grazing at Arcoordaby is noticeable within a 500 m zone of the site. Due to grazing impacts, saltbush recruitment is limited and there is build-up of animal dung in the rock-holes, and the apron pool in particular.

Restoration Potential:

MODERATE: There is good potential for re-establishment of chenopod shrubs due to the sandy nature of the soil and the close proximity of seed source.

The sandy soil is highly erodible and is causing sedimentation of the apron-pool.

Note: Black Bluebush is a good colonising species and generally dominates sites that have been heavily degraded in the past. Bladder Saltbush is also a good coloniser but not as rapid as Black Bluebush. Southern Bluebush is a slower coloniser than Bladder Saltbush, and Pearl Bluebush is a long lived species and is a very slow coloniser, seeding only after very favourable rainfall events recovering at sites that contain limestone within the soil profile.

Current grazing levels in the northern area appear to be high enough to be limiting colonisation of Black Bluebush.

Ecological Investment Priority:

MODERATE: The primary purpose for investment is to stabilise the surrounding environment i.e. erosion, however due to the low species diversity of the site there is a lower ecological value for site investment.

To maintain the tree strata, tree planting may need to occur.

Cultural Investment Priority:

MODERATE: The senior men would like to have the rock-hole fenced off with an adequate buffer to allow for natural regeneration of the landscape. Fencing should be accompanied by cleaning of important rock-holes.

Tomato Camp

Feature	Name	Cultural access	Lease	Date visited
Soak/ Pool/ Kapi Tjurkala	Tomato Camp	Open	North Well	12th June 2009

Site Description	Tomato Camp
Feature	Two soaks on the edge of a salt lake (Lake Harris).
Size / Area	At the time of the visit the soaks were both ~10 x 10 m.
Conceptual understanding	These soaks may fill with a combination of rainfall, surface run-off and groundwater.
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which may have filled these soaks.
Elevation	~130 m
Vegetation association	Surrounding plain was a chenopod shrub-land of *Atriplex vesicaria* (Bladder Saltbush), *Maireana sedifolia* (Pearl Bluebush) and *Maireana pyramidata* (Black Bluebush).

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Track access nearby, short walk to soaks.	Yes	Good	Easy

Figure 15. Edge of Lake Harris where the two soaks were located, one of the soaks is pictured on the right.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Unrecorded
Archaeological	Observations			
	Scatters Historical			

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Abutilon leucopetalum*	Desert Chinese Lantern	Tjirin-tjirinpa (P) (Y)	Roots, kids toy spears
	Ptilotus obovatus	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Tetragonia tetrogonioides	Native Spinach Warrigal Greens	-	-
	Wurmbea sp.	-	Jungul-jungul (K)	Roots
Shrubs	*Atriplex vesicaria*	Bladder Saltbush	Iriya (P) (Y)	-
	[3]*Halosarcia sp.*	Samphire	Mungilypa (P)	Seeds
	Maireana pyramidata	Black Bluebush	-	-
	[1]*Maireana sedifolia*	Pearl Bluebush	-	-
Trees	[2]*Casuarina pauper*	Black Oak	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	Aquatic: 0 species Understory: 4 species Shrub: 4 species Canopy: 1 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	LOW	Shallow pool / pans: 2 shallow pools	Number and size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	?SUB-SALINE – FRESH	Water quality wasn't tested, kangaroos are using it (dead carcasses), and it's marked as a water source on historical and pastoral maps (sheep are able to drink saline water up to TDS 5,000 mg/L).	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	2 soaks / shallow pools in area	Qualitative Survey
7	**Key aquatic refuge**	LOW – MODERATE	A survey was not undertaken, but aquatic invertebrates may occur at the site.	Assumption
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	HIGH	The vegetation association of *Maireana sedifolia* (Pearl Bluebush), *Atriplex vesicaria* (Bladder Saltbush), has been significantly reduced with an increase in the less palatable *Maireana pyramidata* (Black Bluebush)	Qualitative Survey
12	**Dung / dead matter / algae buildup**	HIGH	At least five dead kangaroos are polluting the water in one of the soaks.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. Pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	SLIGHTLY MODIFIED	Some breaks in continuity of vegetation, though close to natural due to environmental conditions of the site being located on edge of a salt lake,	Observation
Nativeness	LARGELY UNMODIFIED	No perennial weeds were recorded at the site.	Observation
Structural Integrity	SLIGHTLY MODIFIED	Historical grazing has impacted the chenopod shrubland at the site. Pearl Bluebush and Bladder Saltbush has decreased with an increase in Black Bluebush.	Observation
Age Structure	SLIGHTLY MODIFIED	Reduced cover of the chenopod shrub layer though three age classes are present.	Observation
Debris	SLIGHTLY MODIFIED	Debris reduced due to shrub cover.	Observation

Table 4: Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Tomato Camp appears to be located within a small fenced paddock, the site has been impacted by either historical stock grazing or current grazing.

Restoration Potential:

MODERATE: If future grazing was minimised it would be expected that the chenopod shrubland species would increase in cover.

Note: Black Bluebush is a good colonising species and generally dominates sites that have been heavily degraded in the past. Bladder Saltbush is also a good coloniser but not as rapid as Black Bluebush. Southern Bluebush is a slower coloniser than Bladder Saltbush. Pearl Bluebush is a long lived species and is a very slow coloniser, seeding only after very favourable rainfall events recovering at sites that contain limestone within the soil profile.

Ecological Investment Priority:

LOW: The site does not exhibit any special ecological attributes that differ from the surrounding landscape i.e. chenopod shrubland and salt lake vegetation.

Cultural Investment Priority:

LOW: Culturally significant site with minimal traditional management required, removal of kangaroo carcasses required.

Figure 16. Two soaks located on the edge of Lake Harris at Tomato Camp, the murky soak (right) contains at least five dead kangaroos.

Tunkillia

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Tunkillia	Open	North Well	12th June 2009

Site Description	Tunkillia
Feature	Granite outcrop with two distinct mounds containing numerous pan rock-holes and an apron pool on the edge of the outcrop.
Size / Area	~300 x 300 m.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~180 m
Vegetation association	Surrounding plain was a chenopod shrub-land of *Atriplex vesicaria* (Bladder Saltbush), *Maireana sedifolia* (Pearl Bluebush) and *Maireana pyramidata* (Black Bluebush).

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Fence access track near-by short 100 m walk to outcrop.	Yes	Good	Easy

Figure 17. The plain surrounding Tunkillia was a chenopod shrub-land dominated by *Maireana pyramidata* (Black Bluebush).

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Unrecorded
Archaeological	Observations			
	Scatters Historical			

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Centipeda thespidioides*	Desert Sneezeweed	Kata-palkalpa (P)	Narcotic, medicine
Shrubs	*Atriplex vesicaria*	Bladder Saltbush	Iriya (P) (Y)	-
	[1,2]*Maireana pyramidata*	Black Bluebush	-	-
	Maireana sedifolia	Pearl Bluebush	-	-
Trees	[3]*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools
	Eremophila longifolia	Weeping Emubush	Tulypurpa (P)	Grubs
	Exocarpus aphyllus	Native Cherry	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	Aquatic: 0 species Understory: 1 species Shrub: 3 species Canopy: 3 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	Shallow pool / pans: +20 pans Apron pool (at granite outcrops): 1 apron pool	Number and size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	A number of rock-holes exist on granite outcrop	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Aquatic invertebrates were observed.	Qualitative Survey
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	HIGH	Vegetation association of *Maireana sedifolia* (Pearl Bluebush) and *Atriplex vesicaria* (Bladder Saltbush) has been reduced and is dominated with *Maireana pyramidata* (Black Bluebush) due to historic grazing.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	HIGH	Dung and dead sheep were fouling the pans and apron pool at this site.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	SLIGHTLY MODIFIED	Trees exist on perimeter of granite outcrop (apron) due to rainfall run-off. There has been a reduction in tree cover (in the immediate area surrounding the outcrop (<100 m).	Observation
Nativeness	LARGELY UNMODIFIED	No perennial weeds were recorded at the site.	Observation
Structural Integrity	SLIGHTLY MODIFIED	Grazing has impacted the perennial saltbush at the site. The chenopod shrubland is dominated by Black Bluebush within 500 m of the site	Observation
Age Structure	SLIGHTLY MODIFIED	Reduced cover of Pearl Bluebush and Bladder Saltbush within 500 m of the site, with Black Bluebush having different age classes present.	Observation
Debris	SLIGHTLY MODIFIED	Loss of debris due to loss in shrub cover.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Stock grazing at Tunkillia is noticeable within a 500 m zone of the site. Due to grazing impacts, saltbush recruitment is limited.

Restoration Potential:

MODERATE: Recovery potential is high for Black Bluebush to regenerate the sandy bare areas immediately surrounding the outcrop, but the recovery of Pearl Bluebush and Bladder saltbush within the 500 m zone of the outcrop would be considerably slower. There is very low recovery potential of the tree strata as there are few individuals and only one age class present.

Ecological Investment Priority:

LOW: The primary purpose for investing in the site is to stabilise the surrounding environment i.e. erosion, however due to the low species diversity of the site there is low ecological value for site investment.

To maintain the tree strata, tree planting would need to occur.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning. Cultural values are being impacted by over-grazing and fouling of rock water. Preferred management option would be fencing of the site to include buffer area of the nearby creek line which is also of cultural significance.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 18. One of the large pan rock-holes at Tunkillia.

KOKATHA STATION

The following cultural and ecological information presented in this report was collected in June 2009 at the one rock-hole site at Kokatha Station.

Pilleutta

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Pilleutta	Open area & Restricted area (Female)	Kokatha	13th June 2009

Site Description	Pilleutta
Feature	Granite outcrop along a ridge containing numerous outcrops and rock-holes.
Size / Area	The ridge and outcrops are spread across ~2.5 km.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	25 mm was recorded at Tarcoola (24-25th May 2009), which had filled the rock-holes visited during the June 2009 field-trip.
Elevation	~160 m
Vegetation association	The outcrops along the ridge were dominated by *Acacia tarculensis* (Tarcoola Wattle) and various *Eremophila* species. The surrounding plain was a chenopod shrub-land of *Atriplex vesicaria* (Bladder Saltbush) and *Maireana pyramidata* (Black Bluebush).

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Track to site.	Yes	Good	Easy

Figure 19. Pilleutta granite outcrop, with Tarcoola Wattle.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open and restricted area	Both and Female area	High	Unrecorded
Archaeological	Observations			
	Scatters Historical	Camp fire		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Chamaesyce drummondii (syn, Euphorbia drummondii)*	Caustic Weed	Ipi-ipi (P) Mangka-mangka (P)	Medicine, decoration
	Cheilanthes lasiophylla	Woolly Cloak Fern	-	-
	Cheilanthes sieberi	-	-	-
	Chrysocephalum pterochaetum	Perennial Sunray	-	-
	Cotula australia	Common Cotula	-	-
	Erodium cygnorum	-	Malu-munpunpa (P) Malu-pumpunya (P)	Seeds
	Isotoma petraea	Rock Isotome	Tjuntiwari (P) (Y) Wanngati (P) (Y)	Narcotic, medicine
	[3]*Ptilotus obovatus*	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Sclerolaena diacantha	Grey Copperburr	Puka-puka (P) Tjilka-tjilka (P) (Y)	-
	Sida corrugata	Corrugate Sida	-	-
	Solanum quadriloculatum	Tomato Bush	Rangki-rangki (P)	Very Poisonous
	Tribulus eichlerianus	Caltrop Bull-head	Walytjapiri	-
Shrubs	[1]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Acacia tetragonophylla	Dead Finish	Kurara (P) (Y) Kurungantiri (P) Wakalpuka (P)	Seeds

	Atriplex vesicaria	Bladder Saltbush	Iriya (P) (Y)	-
	Dodonaea microzyga	Brilliant Hopbush	-	-
	[2]*Eremophila alternifolia*	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Eremophila latrobei	Crimson Emubush	Mintjingka (P) Ngarankura (P)	Nectar
	Eremophila serrulata	Green Emubush	-	-
	Indigofera australis	Australian Indigo	-	-
	Maireana pyramidata	Black Bluebush	-	-
	Maireana sedifolia	Pearl Bluebush	-	-
	Prostanthera striatifolia	Striped Mint-bush	Mintjingka (P) Karingana (P) (Y)	Medicine (leaves boiled or crushed and rub over body for colds and influenza relief)
	Rhagodia parabolica	Mealy Saltbush	-	-
Trees	*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools
	Pittosporum angustifolium	Native Apricot	Alita (P) Kumpalypa (P)	Medicine (seeds grounded and used for a poultice)

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	Aquatic: 0 species Understory: 12 species Shrub: 12 species Canopy: 2 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	Deep pool / pit: apron rock-hole and numerous pans Shallow pool / pans: numerous pans Apron pool (at granite outcrops): 1 apron pool	Number and size of rock-holes were not recorded
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	A number of rock-holes exist on granite outcrop	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Aquatic invertebrates were observed.	Qualitative Survey
8	**Weeds**	ABSENT	None observed.	Qualitative Survey
9	**Exotic animals**	PRESENT	Current impact at site appears to be goat and rabbit grazing.	Qualitative Survey
10	**Water abstraction**	ABSENT	None observed.	Local Knowledge
11	**Grazing pressure**	MODERATE	Browse line on *Acacia tarculensis* ; historical replacement of *Atriplex vesicaria* and *Maireana sedifolia* by *Maireana pyramidata* through stock grazing.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	Some animal dung observed.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Black bluebush in the surrounding area has increased due to historical grazing pressure	Observation
Nativeness	LARGELY UNMODIFIED	No perennial weeds were recorded at the site.	Observation
Structural Integrity	LARGELY UNMODIFIED	All strata present	Observation
Age Structure	LARGELY UNMODIFIED	Dominant strata at the site being the shrub layer. Large populations of shrubs were present.	Observation
Debris	LARGELY UNMODIFIED	Debris present	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Stock grazing is limited directly on the rock outcrop; though there were some dead sheep and build-up of animal dung in the rock-holes, and the apron pool in particular. Goat grazing is having the largest impact at the site.

Photo A: Goat browsing of *Pittosporum angustifolium* (Native Apricot), stripping of branches

Photo B & C: Current goat/sheep grazing of *Acacia* tarculensis (Tarcoola Wattle), note browse line. Also heavy grazing of *Dodonaena microzyga* (Brilliant Hopbush).

Photo D: Chenopod shrub-land showing historical grazing impact, reduction in *Atriplex vesicaria* (Bladder Saltbush) and *Maireana sedifolia* (Pearl Bluebush), with increased *Maireana pyramidata* (Black Bluebush) cover.

Restoration Potential:

HIGH: Due to diversity of plants and age structure, if goat control was undertaken at the site, the recovery of grazed species would occur.

Ecological Investment Priority:

HIGH: The site had a large diversity of different shrub species with minimal population replacement observed. The main threats to the site are grazing by goats, rabbits and sheep; with goats preferentially browsing the shrubs, while rabbits may be impacting seedling growth. This is a high value granite outcrop site due to its ecological (diverse array of plants) and cultural importance (presence of medicinal and food plants).

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning. The women would like to have a community event (Inma) at the site.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

MOONAREE STATION

Two sites containing granite outcrops with rock holes were visited on Moonaree Station in April and June 2010. The cultural information was collected during a site visit in April, while the ecological surveys were undertaken in June.

Yardin / Dingo Hill

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Dingo Hill	Open area & Restricted area (Male)	Moonaree	27th June 2010

Site Description	Dingo Hill
Feature	Granite ridge with outcrops seven pit rock-holes and one apron pool.
Size / Area	Rock-holes occurred along an 800 m section of the ridge.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~200 m
Vegetation association	The hill slope was an *Acacia tarculensis* (Tarcoola Wattle) woodland. The surrounding plain was a *Maireana pyramidata* (Black Bluebush) and *Maireana triptera* (Three-wing Bluebush) chenopod shrubland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Had to leave the track to find the site, local knowledge of area needed.	No	Average	Difficult-hard

Figure 20. Photograph of the plain surrounding Dingo Hill. Vegetation association consists of *Maireana pyramidata* (Black Bluebush) and *Maireana triptera* (Three-wing Bluebush) shrubland.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open and restricted area	Both and Male area	High	Unrecorded
Archaeological	Observations			
	Scatters Historical	Stone arrangements		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	*Limosella granitica*	Granite Mudwort	-	-
Grasses / forbs	**Brassica tournefortii*	Wild Turnip	-	-
	Cheilanthes lasiophylla	Woolly Cloak Fern	-	-
	[1]*Ptilotus obovatus*	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
Shrubs	[3]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Acacia tetragonophylla	Dead Finish	Kurara (P) (Y) Kurungantiri (P) Wakalpuka (P)	Seeds
	Enchylaena tomentosa	Ruby Saltbush	Iwatiwata (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Eremophila latrobei	Crimson Emubush	Mintjingka (P) Ngarankura (P)	Nectar
	Maireana sedifolia	Pearl Bluebush	-	-
	[2]*Maireana triptera*	Three-wing Bluebush	-	-
	Rhagodia parabolica	Mealy Saltbush	-	-
Trees	*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'value' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	HIGH	Aquatic: 1 submerged species Understory: 3 species Shrub: 7 species Canopy: 1 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	Deep pool / pit: 7 pits Apron pool (at granite outcrops): 1 apron pool	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	170 µS at rock-hole that was cleaned out 8-10 weeks ago; 550 µS at rock-hole not cleaned out.	YSI Multi-parameter
5	**Cultural site**	HIGH	Significant Aboriginal site. European: Stone Cairn probably built during the Afghan era.	Local Knowledge
6	**Uniqueness**	MODERATE	7 rock-holes exist in the area across 3 outcrops.	Qualitative Survey
7	**Key aquatic refuge**	MODERATE	*Limosella granitica* (Granite Mudwort) is listed as a vulnerable species (DEH West Region, 2007). 4 species of aquatic invertebrates (Appendix A).	Qualitative Survey (sample not verified) High: EPA identification
8	**Weeds**	PRESENT	**Brassica tournefortii* (Wild Turnip) was recorded growing in one of the rock holes.	Qualitative Survey
9	**Exotic animals**	ABSENT	None identified.	Qualitative Survey
10	**Water abstraction**	HISTORIC	Evidence of rocks piled on the larger apron pool to hold water, possibly made by Aboriginal, Afghan or pastoralists.	Local Knowledge
11	**Grazing pressure**	LOW	Currently there is little grazing on shrubs, and there is Mulga regeneration at site.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	MODERATE	Apron pool had a lot of sheep and kangaroo dung in water/sediment of pool.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Connection of rock outcrop flora with surrounding landscape	Observation
Nativeness	LARGELY UNMODIFIED	No high impact weed species were observed at the site.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum, with the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	Dominant shrub strata consisting of *Maireana triptera* (Three-wing Bluebush) and *Ptilotus obovatus* (Silver Mulla Mulla) with both of these species having adults, sub-adults and seedlings present. Foliage cover of these species is normal. There is also evidence of Mulga regeneration with sub-adults being present at the site.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system, annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Stock is not having a significant impact at the site, though there is build-up of both sheep and kangaroo dung in the rock-holes, the apron pool in particular.

Restoration Potential:

INTACT: Ensure that current land management practices are maintained (minimal stock grazing).

Ecological Investment Priority:

INTACT: This rock-hole is in good condition with minimal threats noted. Land management practices should be maintained.

Recording of the vulnerable plant species *Limosella granitica* (Granite Mudwort) (DEH West Region, 2007) at the site should be lodged with the South Australian herbarium.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 21. Mick Starkey June 2010, removing stone cap placed over a pit rock-hole that was cleaned on the previous field trip in April 2010.

Murnea

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Murnea	Open	Moonaree	27th June 2010

Site Description	Murnea
Feature	Granite outcrop containing two pit and approximately ten pan rock-holes.
Size / Area	The outcrop was ~25 m in length with two pit rock-holes and numerous pan rock-holes.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~145 m
Vegetation association	*Acacia aneura* (Mulga) woodland with *Dodonaea viscosa* (Sticky Hopbush) shrubland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Had to leave the main road, local knowledge of area needed.	No	Average	Difficult-hard

Figure 22. Murnea granite outcrop surrounded by *Dodonaea viscosa* (Sticky Hopbush) shrubland

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Unrecorded
Archaeological	Observations			
	Scatters	Burial Site		
	Camp Fire	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Ptilotus obovatus*	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Sclerolaena obliquicuspis	Limestone Copperburr	Puka-puka (P)	-
	[3]*Solanum quadriloculatum*	Tomato Bush	Rangki-rangki (P)	Very Poisonous
Shrubs	[1,2]*Dodonaea viscosa*	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	Enchylaena tomentosa	Ruby Saltbush	Iwatiwata (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Rhagodia spinescens	Thorny Saltbush	-	-
	2 x unidentified shrubs			
Trees	*Acacia aneura*	Mulga	Kalpilya (P) Kurku (P) (Y) Minyura (P) Puyukara (P) Tjamalya (P) Wanari (P) Wintalyka (P) (Y)	Seeds, Artefacts, tools
	Acacia papyrocarpa	Western Myall	-	-
	Acacia sp.			
	Pittosporum angustifolium	Native Apricot	Alita (P) Kumpalypa (P)	Medicine (seeds grounded and used for a poultice)

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	*Aquatic*: 0 species *Understory*: 3 species *Shrub:* 5 species *Canopy:* 3 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	*Shallow pool / pan:* ~10 pan rock-holes *Deep pool / pit:* 2 pit rock-holes	High
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	TDS 50 mg/L at rock-hole that was cleaned out on 7th April 2010; TDS 112 mg/L at rock-hole not cleaned out.	YSI Multi-parameter
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	Two pit and numerous pan rock-holes exist on the granite outcrop.	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Aquatic invertebrates present	Qualitative Survey
8	**Weeds**	ABSENT	None observed	Qualitative Survey
9	**Exotic animals**	PRESENT	Moderate number of rabbit diggings/scratchings and scats/buck-heaps at the site.	Qualitative Survey
10	**Water abstraction**	ABSENT		High
11	**Grazing pressure**	HIGH	The light sandy soil is being easily eroded by high kangaroo numbers using the rock-hole which is impacting the site rather than grazing.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	MODERATE	Some algae in the rock-hole that was not cleaned out in the previous month (April 2010).	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No loss of native species, though the site is being impacted by indicator species of mobile /degraded soils.	Observation
Nativeness	LARGELY UNMODIFIED	No high threat or high impact species present.	Observation
Structural Integrity	SLIGHTLY MODIFIED	Disturbance and removal of topsoil at the site is due to rabbit and kangaroo tracks and grazing pressure. This has reduced the cover and abundance of understory species at the site.	Observation
Age Structure	LARGELY UNMODIFIED	The dominant shrub species at the site was *Dodonaea viscosa* (Sticky Hopbush) which was ungrazed and had adult, sub-adults and seedlings present.	Observation
Debris	MODERATELY MODIFIED	Kangaroo and rabbit activity has caused soil to erode and become mobile.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system, annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

Due to kangaroo and rabbit activity at the site it has caused soil to erode and become mobile. These observations are supported by the increase in density of indicator plant species of mobile/degraded soils such as *Dodonaea viscosa* (Sticky Hopbush), *Sclerolaena obliquicuspis* (Limestone Copperburr), and *Solanum quadriloculatum* (Tomato Bush).

Soil humping around plants such as Spinifex, indicates that soil erosion has occurred at the site and that the topsoil is susceptible to future wind erosion and soil disturbance from stocks and kangaroos.

Restoration Potential:

MODERATE: Due to the mobility of the soils, the rock-holes at this site are more likely to be continually impacted by sedimentation.

To prevent continued soil erosion, a number of land remediation options could be investigated for the site if deemed appropriate.

Ecological Investment Priority:

MODERATE: The primary purpose for investing into management at the site is to stabilise the surrounding environment i.e. erosion of the sandy topsoil. The site appears to be heavily utilised by kangaroos due to the high density of tracks at the site, supporting the reasoning to keep the rock-holes clean of sediment so the native animals can continue to use this water source.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 23. Limited understory and groundcover due to high impact by rabbit and kangaroos, *Solanum quadriloculatum* an indicator species of disturbance is in the foreground.

KOWERIDDA STATION

One site was visited in April and June 2010 at Koweridda Station that consisted of a granite outcrop on top of a hill that contained rock-holes. The cultural information was collected during a site visit in April, while the ecological surveys were undertaken in June.

Koweridda Outstation

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Koweridda Outstation	Restricted (Male)	Koweridda	28th June 2010

Site Description	Koweridda Outstation
Feature	Granite ridge containing four pit rock-holes.
Size / Area	Numerous rock-holes along a 150 m section of a ridgeline.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~180 m
Vegetation association	Hill slope was a*Triodia irritans* (Spinifex) hummock grassland, with the surrounding plains being a *Maireana pyramidata* (Black Bluebush) with *Alectryon oleifolius* (Bullock Bush) shrubland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track to bottom of hill.	No	Good	Easy

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Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Restricted	Male	High	Registered
Archaeological	Observations			
	Scatters Art/Engravings	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	*Limosella granitica*	Granite Mudwort	-	-
Grasses / forbs	[1]*Ptilotus obovatus*	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Solanum petrophilum	Rock-Nightshade	Tjilka-tjilka (P) (Y)	Poisonous
	[2]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Acacia tetragonophylla	Dead Finish	Kurara (P) (Y) Kurungantiri (P) Wakalpuka (P)	Seeds
	Enchylaena tomentosa	Ruby Saltbush	Iwatiwata (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	[3]*Eremophila alternifolia*	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Rhagodia parabolic	Mealy Saltbush	-	-
	Acacia sp.			
	Acacia sp.			
Trees	*Alectryon oleifolius*	Bullock Bush	Tjalura (P)	?Buds
	Eremophila longifolia	Weeping Emubush	Tulypurpa (P)	Grubs
	Eucalyptus sp.	Mallee sp.	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	HIGH	***Aquatic:*** 1 species ***Understory:*** 3 species ***Shrub:*** 7 species ***Canopy:*** 3 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	LOW	***Deep pool / pit:*** 4 pits	High
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Assumption
5	**Cultural site**	HIGH	Significant Aboriginal site.	Local Knowledge
6	**Uniqueness**	MODERATE	Numerous rock-holes occur at the site	Qualitative Survey
7	**Key aquatic refuge**	MODERATE - HIGH	*Limosella granitica* (Granite Mudwort) is listed as a vulnerable species (DEH West Region, 2007)	Qualitative Survey (sample not verified)
8	**Weeds**	ABSENT	None observed	Qualitative Survey
9	**Exotic animals**	ABSENT	None Observed	Qualitative Survey
10	**Water abstraction**	ABSENT	Absent	Qualitative Survey
11	**Grazing pressure**	LOW	Some grazing of *Eremophila alternifolia.*	Qualitative Survey
12	**Dung / dead matter / algae buildup**	MODERATE	Algae present in rock-hole.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. Pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No loss of native species.	Observation
Nativeness	LARGELY UNMODIFIED	No high threat or high impact species present.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum, with the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	There was regeneration of *Eremophila alternifolia* and Acacia species with adults and sub-adults being present.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system, annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

The holding paddock that Koweridda Outstation rock-holes are located in was un-stocked at time of survey. There was minimal evidence of grazing on shrubs,

Restoration Potential:

INTACT: Ensure that current land management practices are maintained.

Ecological Investment Priority:

INTACT: This rock-hole site is in good condition with minimal threats noted.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

THURLGA STATION

Four sites were visited in June 2010 at Thurlga Station which consisted of; one granite outcrop on top of a hill that contained rock-holes (Thurlga Homestead) and three headwater pools (Hudson's, Tandaie and Spring Hill). Both the cultural and ecological information was collected during a site visit in June 2010.

Figure 24. Members of the field trip; Gawler Ranges Native Title Committee, South Australian Native Title Services and the Department for Water with Ian Morris, the pastoralist from Thurlga.

Thurlga Homestead

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Thurlga Homestead	Open	Thurlga	30th June 2010

Site Description	Thurlga Homestead
Feature	Granite ridge containing two pit rock-holes.
Size / Area	Numerous rock-holes along a ~50 m section of a ridgeline.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	290 m.
Vegetation association	Mixed acacia shrub-land.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track to bottom of hill.	No	Good	Difficult-Hard

Figure 25. The ridge outcrop at Thurlga Homestead that had two pit rock-holes.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	Medium	Unrecorded
Archaeological	Observations			

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	**Carrichtera annua*	Wards Weed	-	-
	Euphorbia tannensis ssp.	Desert Spurge	Ipi-ipi (P)	Decoration, medicine
	Isotoma petraea	Rock Isotome	Tjuntiwari (P) (Y) Wannga̲ti (P) (Y)	Narcotic, medicine
	Solanum petrophilum	Rock-Nightshade	Tjilka-tjilka (P) (Y)	Poisonous
	Solanum sturtianum	Sturts Nightshade	-	Likely poisonous
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	*Acacia continua*	Thorny Wattle	-	-
	Acacia sp.			
	Acacia sp.			
	Acacia sp.			
	Bursaria spinosa	Blackthorn	-	-
	Cryptandra amara	Bitter Cryptandra	-	-
	Dodonaea lobulata	Lob-leaf Hopbush	-	-
	[2]*Dodonaea viscosa*	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P) Tar̲itjanpa (P)	Medicine
	Eremophila serrulata	Green Emubush	-	-
	Eutaxia microphylla	Mallee Bush-pea	-	-
	Lycium austral	Australian	-	-

		Boxthorn		
	Philotheca linearis	-	-	-
	Senna artemisioides	Silver Cassia	Karpil-karpilpa (P) Arapita (P) Inuntji (P) (fresh growth & flowers) Pilani (P) Punti (P) Untunu (P)	Medicine (leaves are boiled and are put into a cream for aches and pains) (K) Grubs
	Senna artemisioides	Punty Bush	-	-
	Rhagodia parabolica	Mealy Saltbush	-	-
	3 x unidentified species			
Trees	[3]*Eucalyptus socialis*	Red Mallee	Ngapari (P) (Y) Pulura (P) Tjintjulu	Seeds, nectar, water from roots, ceremonial

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	***Aquatic:*** 0 species ***Understory:*** 6 species ***Shrub:*** 19 species ***Canopy:*** 1 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	LOW	***Deep pool / pit:***2 pits	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	YSI Multi-parameter
5	**Cultural site**	MODERATE	Of moderate Aboriginal significance.	Local Knowledge
6	**Uniqueness**	MODERATE	More than one rock-hole at site	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Aquatic invertebrates observed.	Qualitative Survey
8	**Weeds**	PRESENT	**Carrichtera annua* (Ward's Weed) was dense on the foot slopes, but only moderately dense on top of the hill at the rock-hole site.	Qualitative Survey
9	**Exotic animals**	ABSENT	None Observed	Qualitative Survey
10	**Water abstraction**	ABSENT	Absent	Qualitative Survey
11	**Grazing pressure**	LOW	Homestead paddock, not a lot of grazing observed on the ridge.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	None observed.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No loss of native species.	Observation
Nativeness	SLIGHTLY MODIFIED	*Carrichtera annua* (Wards Weed) is present at the site but is not dominating the site at the top of the rock outcrop where there is a high diversity and cover of natives.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum (except the aquatic plant strata which only occurs at limited sites), the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	There were many different ages in the shrub strata.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system, annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Management Considerations

Current Management:

The homestead paddock that Thurlga rock-holes are located in was un-stocked at time of survey. There was minimal evidence of grazing on shrubs.

Restoration Potential:

INTACT: Ensure that current land management practices are maintained.

Ecological Investment Priority:

INTACT: This rock-hole site was in good condition with minimal threats noted.

Cultural Investment Priority:

INTACT: Cultural site with current pastoral management to be maintained.

Figure 26. Thurlga Homestead rock-hole site during a rainfall event.

Hudson's

Feature	Name	Cultural access	Lease	Date visited
Headwater pools / Kapi Tjurkala	Hudson's	Open	Thurlga	29th June 2010

Site Description	Hudson's
Feature	Granite outcrop in a headwater creek line that had a rock platform containing rock-holes. Stone weir within creek line above the rock platform.
Size / Area	A small rock platform less than 50 m with numerous shallow pan rock-holes.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~280 m
Vegetation association	Surrounding hill slope was a *Triodia irritans* (Spinifex) hummock shrubland. The creek line was Eucalyptus open woodland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track to site.	Yes	Good	Easy

Figure 27. The rock platform with numerous rock-hole pans below the stone weir.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Recorded
Archaeological	Observations			
	Scatters Historical			

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	**Carrichtera annua*	Wards Weed	-	-
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Bursaria spinosa	Blackthorn	-	-
	Dodonaea viscosa	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	Enchylaena tomentosa	Ruby Saltbush	Iwatiwata (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Eremophila serrulata	Green Emubush	-	-
	Eutaxia microphylla	Mallee Bush-pea	-	-
	[3]*Rhagodia parabolica*	Mealy Saltbush	-	-
	Senna artemisioides	Punty Bush	-	-
Trees	*Alectryon oleifolius*	Bullock Bush	Tjalura (P)	?Buds
	Casuarina pauper	Black Oak		-
	[2]*Eucalyptus socialis*	Red Mallee	Ngapari (P) (Y) Pulura (P) Tjintjulu (Y)	Seeds, nectar, water from roots, ceremonial
	Exocarpus aphyllus	Native Cherry	-	-

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	***Aquatic:*** 0 species ***Understory:*** 2 species ***Shrub:*** 9 species ***Canopy:*** 4 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	HIGH	***Shallow pool / pan:*** numerous rock-hole pans on platform. ***Waterfall:*** one significant rock ledge (weir built at top of waterfall). ***Weir pool:*** rock weir in creek-line, with a small pool of water (5 x 3 m) held behind the weir.	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	SUB-SALINE	Depth 25cm, 10ºC, 6.5pH, TDS 520 mg/L	YSI Multi-parameter
5	**Cultural site**	HIGH	Aboriginal rock engravings European Heritage; old stone weir.	Qualitative Survey
6	**Uniqueness**	MODERATE - HIGH	Numerous rock holes, though only the weir pool would hold water for extended periods of time.	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Tadpoles present in rock-hole pans and weir-pool. 7 species of Aquatic Invertebrates (Appendix A)	Qualitative Survey High: EPA identification
8	**Weeds**	PRESENT	**Carrichtera annua* (Ward's Weed) was dense at the site.	Qualitative Survey
9	**Exotic animals**	ABSENT	Not at site (Ian Morris pers comm.) eg. goats are controlled.	Qualitative Survey
10	**Water abstraction**	ABSENT	Absent, though weir is constructed above the rock-holes	Qualitative Survey
11	**Grazing pressure**	MODERATE	Directly at site; *Casuarina pauper* (Black Oak) and *Eutaxia microphylla* were heavily grazed, most likely a combination of sheep and kangaroo grazing. Once 200 m away from site/water, the *Casuarina pauper* (Black Oak) was not grazed.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	No obvious algal growth though the weir-pool was turbid from vegetation and animal dung decomposition.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. Pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Immediate connection in vegetation from the creek line to the Spinifex hill-slope	Observation
Nativeness	MODERATELY MODIFIED	*Carrichtera annua* (Wards Ward) dominated the understory strata.	Observation
Structural Integrity	SLIGHTLY MODIFIED	There are plant species in each stratum (except the aquatic plant strata which only occurs at limited sites). The foliage cover in the shrub strata has been grazed immediately at the site.	Observation
Age Structure	SLIGHTLY MODIFIED	The Eucalyptus (Mallee) at the site had both adults and sub-adults present	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Management Considerations

Current Management:

Some shrubs are being impacted by grazing directly at the site, at distances greater than 100 m away from the site the palatable shrubs are not as severely grazed.

Overall the site is in good condition.

Restoration Potential:

INTACT: Overall the site is in good condition though some grazing of shrubs was occurring at the site, if minimised the site would recover due to the diversity and age range of plants at the site.

Ecological Investment Priority:

INTACT: Overall the site at Hudson's is in good condition with minimal threats noted. Monitoring of grazed shrubs could be undertaken to ensure that the impact does not spread beyond 100 m or cause a reduction of diversity of plants at the site.

Cultural Investment Priority:

INTACT: Culturally significant site with traditional management to be undertaken including visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 28. Creek line that Hudson's rock hole and stone weir occur in.

Tandaie

Feature	Name	Cultural access	Lease	Date visited
Headwater pools /Kapi Tjurkala	Tandaie	Open	Thurlga	30th June 2010

Site Description	Tandaie
Feature	Granite outcrop in a spring-fed creek line (creekline) that had a series of pools.
Size / Area	Numerous pools of water existed along a ~300 m section of creek line in the rocky creek line.
Conceptual understanding	These pools were not typical rock-holes and are situated in a rocky creek line. It is assumed that these pools are filled from rain-fall runoff and spring-fed during seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~300 m
Vegetation association	Surrounding hill slope was a *Triodia irritans* (Spinifex) hummock shrubland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track to site.	Yes	Good	Easy

Figure 29. Lynette Ackland (SANTS) at a headwater pool at Tandaie.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Recorded
Archaeological	Observations			
	Art/Engravings Scatters	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	Unidentified sp.			
Grasses / forbs	**Marrubium vulgare*	Horehound	-	-
	Solanum petrophilum	Rock-Nightshade	Tjilka-tjilka (P)	Poisonous
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	[3]*Dodonaea viscosa*	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	[2]*Eremophila alternifolia*	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Senna artemisioides	Silver Cassia	Karpil-karpilpa (P) Arapita (P) Inuntji (P) (fresh growth & flowers) Pilani (P) Punti (P) Untunu (P)	Medicine (leaves are boiled and are put into a cream for aches and pains) (K) Grubs
Trees	*Melaleuca sp.*	-	-	-
	Alectryon oleifolius	Bullock Bush	Tjalura (P)	?Buds

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	HIGH	***Aquatic:*** 1 species ***Understory:*** 3 species ***Shrub:*** 3 species ***Canopy:*** 2 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	***Shallow pool / pan:*** numerous shallow rock pools ***Waterfall:*** a series of ledges with pools at the bottom of each waterfall	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	SUB-SALINE	Various depth of pools ranging from 17-40cm. At one pool; Depth 40cm, 8ºC, 6.5pH, TDS 938 mg/L.	YSI Multi-parameter
5	**Cultural site**	HIGH	Aboriginal rock engravings, stone tool chippings	Qualitative Survey
6	**Uniqueness**	MODERATE	Numerous pools along creek line.	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	9 species of aquatic invertebrates (Appendix A) Tadpoles of *Neobatrachus pictus* (a species of burrowing frog) of which ~ ¼ of them had nematodes (worms) attached to them.	High: EPA identification
8	**Weeds**	PRESENT	**Marrubium vulgare* (Horehound) present at the site.	Qualitative Survey
9	**Exotic animals**	PRESENT	Recent shooting of goats occurred directly at the by DENR, site only 2km from park boundary (Ian Morris pers comm.)	Qualitative Survey
10	**Water abstraction**	ABSENT		Qualitative Survey
11	**Grazing pressure**	REDUCED	Due to the recent goat shoot (+6mths); plants that were previously severely grazed down to the base had reshot.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	MODERATE	Algal growth present in pools. Of concern was the dead goats shot within meters of water, potentially fouling the water.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. Present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Immediate connection in vegetation from the creek line to the Spinifex hill-slope	Observation
Nativeness	LARGELY UNMODIFIED	No high threat or high impact species present.	Observation
Structural Integrity	SLIGHTLY MODIFIED	There are plant species in each stratum. The foliage cover in the shrub strata of *Eremophila alternifolia* had been severely grazed by goats but was recovering due to recent goat shoot.	Observation
Age Structure	LARGELY UNMODIFIED	Regeneration of *Eremophila alternifolia* (Irmangka-Irmangka) with adults and sub-adults present. Also adults and sub-adults of *Senna artemisioides* (Silver Cassia).	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system, annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Management Considerations

Current Management:

Goat control had occurred at Tandaie in the previous 6-12 months however there had been severe grazing of recovering *Eremophila alternifolia* (Irmangka-Irmangka) foliage.

Restoration Potential:

MODERATE: Continued goat control to ensure full recovery of foliage cover of plants that had been severely grazed and allow for seedlings and sub-adults to mature without being grazed.

Ecological Investment Priority:

MODERATE: Continued investment into goat control to ensure full recoverability of shrubs. This site is located on the boundary with Gawler Ranges National Park, with goats previously using this route via Tandaie when leaving the park.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 30. Recovery of foliage cover of *Eremophila alternifolia* (Irmangka-Irmangka) that had been severely grazed by goats.

Spring Hill

Feature	Name	Cultural access	Lease	Date visited
Headwater pools / Kapi Tjurkala	Spring Hill	Open	Thurlga	29th June 2010

Site Description	Spring Hill
Feature	A headwater creek line that had a series of waterfalls with rock pools at the bottom of each.
Size / Area	Four pools were recorded along ~210 m section of the creek line.
Conceptual understanding	These pools were not typical rock-holes and are situated in a rocky creek line. It is assumed that these pools are filled from rain-fall runoff and spring-fed during seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	From 230 – 280 m.
Vegetation association	Surrounding hill slope was a *Triodia irritans* (Spinifex) hummock shrubland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track to site.	Yes	Good	Easy

Figure 31. The rock platform / waterfall within the Spring Hill creek line.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Unrecorded
Archaeological	Observations			
	Art/Engravings Scatters	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Cheilanthes lasiophylla*	Woolly Cloak Fern	-	-
	Cheilanthes sieberi	-	-	-
	Ptilotus obovatus	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Purar-purarpa (P)	Grubs
	Salsola kali	Roly-poly	Tjilkala (P) (Y) Iriya (Y)	Grubs
	Sida petrophila	-	-	-
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	[3]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Dodonaea viscosa	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	Eremophila serrulata	Green Emubush	-	-
	[2]*Senecio magnificus*	Showy Groundsel	Liru-liru (P) (Y)	-
Trees	*Acacia sp.*	-	-	-
	Acacia sp.	-	-	-
	Alectryon oleifolius	Bullock Bush	Tjalura (P)	?Buds

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE-HIGH	***Aquatic:*** 0 species ***Understory:*** 6 species ***Shrub:*** 4 species ***Canopy:*** 3 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	***Shallow pool / pan:*** 4 shallow rock pools ***Waterfall:*** a series of ledges with pools at the bottom of each waterfall ***Seepage film (rock surfaces):*** numerous black films were observed on the waterfall rock faces.	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	YSI Multi-parameter
5	**Cultural site**	HIGH	Aboriginal rock engravings, stone tool chippings.	Local Knowledge
6	**Uniqueness**	MODERATE	4 pools along creek line.	Qualitative Survey
7	**Key aquatic refuge**	LOW	No aquatic fauna were observed.	Qualitative Survey
8	**Weeds**	ABSENT		Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT		Local Knowledge
11	**Grazing pressure**	LOW	No grazing pressure observed at site.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	Some animal dung present in the rock-pools.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	Immediate connection in vegetation from the creek line to the Spinifex hill-slope	Observation
Nativeness	LARGELY UNMODIFIED	No high threat or species present.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum (except the aquatic plant strata which only occurs at limited sites). The foliage cover in the shrub strata is natural.	Observation
Age Structure	MODERATELY MODIFIED	Tree strata was dominant with only one age class present of *Acacia tarculensis* (Tarcoola Wattle). Though there is no reduced cover of this strata.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

There are no grazing impacts at the site, though the site is an informal camping site with the car park currently situated on top of scatters.

Restoration Potential:

INTACT: Ensure that current land management practices are maintained.

Ecological Investment Priority:

INTACT: This spring site was in good condition with minimal threats noted.

Cultural Investment Priority:

MODERATE: It is recommended that the car park is moved to stop further damage to Aboriginal scatters.

Culturally significant site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 32. Pools of water flowing down the Spring Hill creek line in June 2010.

YARDEA STATION

Three sites were visited in June 2010 on the Yardea pastoral lease in the Gawler Ranges which consisted of; one granite outcrop containing rock-holes (Kulkalla), and two granite outcrops in a creek line that had headwater pools (Yardea Homestead and Artaming). Both the cultural and ecological information was collected during a site visit in June 2010.

Figure 33. Members of the field trip; Gawler Ranges Native Title Committee, South Australian Native Title Services and the Department for Water with Sandy Morris, the pastoralist from Yardea.

Artaming

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Artaming	Open	Yardea	1st July 2010

Site Description	Yardea Homestead
Feature	Granite outcrop in a spring fed creek line that had a waterfall with a couple of rock-pools along the creek.
Size / Area	Two pools at the bottom of the creek line in a creek line, 30 m apart.
Conceptual understanding	These pools are not typical rock-holes and are situated in a rocky creek line. It is assumed that these pools are spring-fed during and after seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~ 255 m.
Vegetation association	The hill slope was a *Triodia irritans* (Spinifex) hummock grassland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track nearby, park and walk to site.	No	-	Difficult

Figure 34. A headwater pool within the creek line at Artaming.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	Medium	Unrecorded
Archaeological	Observations			
	Scatters			

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	**Carrichtera annua*	Wards Weed	-	-
	Cheilanthes sieberi	-	-	-
	Dianella revoluta sp.	-	-	-
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	*Acacia sp.*	-	-	-
	[3]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	[2]*Dodonaea viscosa*	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P) Taritjanpa (P)	Medicine
	Rhagodia parabolica	Mealy Saltbush	-	-
	Senecio magnificus	Showy Groundsel	Liru-liru (P) (Y)	-
	Senna artemisioides var. ?zygophylla(NSW)	Punty Bush	-	-
	1 x unidentified sp.			
Trees	*Pittosporum angustifolium*	Native Apricot	Alita (P) Kumpalypa (P)	Medicine (seeds grounded and used for a poultice)

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	***Aquatic:*** 0 species ***Understory:*** 4 species ***Shrub:*** 8 species ***Canopy:*** 1 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	LOW	***Shallow pool / pans:*** 2 pools.	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Local Knowledge
5	**Cultural site**	LOW	Not a significant site	Local Knowledge
6	**Uniqueness**	HIGH	Ecological: Yes, only site that has been visited that has had *Dianella revoluta.*	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	6 species of aquatic invertebrates (Appendix A) Tadpoles were present.	High: EPA identification
8	**Weeds**	PRESENT	**Carrichtera annua* (Ward's Weed) was dense on the foot slopes, but only moderately dense in the creekline.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	No.	Qualitative Survey
11	**Grazing pressure**	MODERATE	A lot of euro dung was present with grazing apparent on *Eremophila sp.* and a sheep browse line on Acacia tarculensis (Tarcoola Wattle).	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	None observed.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No loss of native species.	Observation
Nativeness	MODERATELY MODIFEID	*Carrichtera annua* (Wards Weed) dominated the understory strata.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum (except the aquatic plant strata which only occurs at limited sites), the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	*Dodonaea viscosa* (Hopbush) adults, sub-adults and seedlings present; *Acacia sp.* adults and sub-adults present. Foliage cover of both species was natural.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Management Considerations

Current Management:

There was moderate grazing on shrubs at the site.

Restoration Potential:

INTACT: Maintain current land management practices at the site.

Ecological Investment Priority:

INTACT: This spring site was in good condition with minimal threats noted.

Cultural Investment Priority:

INTACT: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 35. Example of sheep browse line on Tarcoola Wattle.

Kulkalla

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Kulkalla	Open	Yardea	2nd July 2010

Site Description	Kulkalla
Feature	Granite outcrop on a hill slope containing two pit rock-holes and one pan rock-hole.
Size / Area	Rock outcrop was ~20 m in width and length.
Conceptual understanding	Rock-holes fill with seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	~ 220 m.
Vegetation association	The hill slope was a combination of *Triodia irritans* (Spinifex) hummock grassland and *Acacia tarculensis* (Tarcoola Wattle). The lowland/ valley was an *Atriplex vesicaria* (Bladder Saltbush) and *Maireana sedifolia* (Pearl Bluebush) shrubland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
No track, closest pastoral track ~4 km away, local knowledge needed to walk into the site.	No	-	Hard

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	High	Unrecorded
Archaeological	Observations			
	Art/Engravings Scatters	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	-	-	-	-
Grasses / forbs	*Abutilon sp.*	-	-	-
	**Carrichtera annua*	Wards Weed	-	-
	Isotoma petraea	Rock Isotome	Tjuntiwari (P) (Y) Wannga̲ti (P) (Y)	Narcotic, medicine
	[2]*Ptilotus obovatus*	Silver Mulla Mulla	Iriya (P) (Y) Kuntultji (P) Pu̲r-pu̲rarpa (P)	Grubs
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	[3]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Acacia tetragonophylla	Dead Finish	Ku̲rara (P) Ku̲rungantiri (P) Wakalpuka (P)	Seeds
	Atriplex vesicaria	Bladder Saltbush	Iriya (P) (Y)	-
	Dodonaea lobulata	Lob-leaf Hopbush	-	-
	Enchylaena tomentosa	Ruby Saltbush	Iwa̲tiwa̲ta (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P) Ta̲ritjanpa (P)	Medicine
	Lycium austral	Australian Boxthorn	-	-
	Maireana sedifolia	Pearl Bluebush	-	-
	Rhagodia parabolica	Mealy Saltbush	-	-
	Senna artemisioides	Silver Cassia	Karpil-karpilpa (P) Arapita (P) Inuntji (P) (fresh	Medicine (leaves are boiled and are put into a cream for aches and

			growth & flowers) Pilani (P) Punti (P) Untunu (P)	pains) (K) Grubs
Trees	*Alectryon oleifolius*	Bullock Bush	Tjalura (P)	?Buds
	Pittosporum angustifolium	Native Apricot	Alita (P) Kumpalypa (P)	Medicine (seeds grounded and used for a poultice)

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Figure 36. Mick Starkey (SANTS), Jacinda Fennell (SAAL NRM Board) and Mel White (DFW) at the small rock outcrop of Kulkalla on a hill slope containing two pits.

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	***Aquatic:*** 0 species ***Understory:*** 5 species ***Shrub:*** 10 species ***Canopy:*** 2 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	MODERATE	***Deep pool / pits:*** 2 pit rock-holes. ***Shallow pool / pans:*** 1 pan rock-hole	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Qualitative Survey
5	**Cultural site**	HIGH	Aboriginal: Engravings and grinding areas on rock surface European: Stone cairn (Afghan?)	Local Knowledge
6	**Uniqueness**	HIGH	Ecological: Yes, deepest pit recorded so far on project.	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	4 species of aquatic invertebrates (Appendix A)	High: EPA identification
8	**Weeds**	PRESENT	**Carrichtera annua* (Ward's Weed) was moderately dense on the foot slopes.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed.	Qualitative Survey
10	**Water abstraction**	ABSENT	No.	Local Knowledge
11	**Grazing pressure**	LOW	No browse lines on *Acacia tarculensis* (Tarcoola Wattle) and *Eremophila alternifolia* (Irmangka-Irmangka) not heavily grazed. Within 1km of site *Maireana sedifolia* (Pearl Bluebush) seedlings and *Acacia aneura* (Mulga) sub-adults were seen, also indicating low grazing.	Qualitative Survey
12	**Dung / dead matter / algae buildup**	MODERATE	Filamentous algae was present in the rock hole.	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No loss of native species.	Observation
Nativeness	LARGELY UNMODIFIED	No high threat or high impact species present.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum (except the aquatic plant strata which only occurs at limited sites), the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	Within 1km of site *Maireana sedifolia* (Pearl Bluebush) seedlings and *Acacia aneura* (Mulga) sub-adults were seen. Foliage cover at the site was natural.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system, annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

There were no grazing impacts at the site.

Restoration Potential:

INTACT: Ensure that current land management practices are maintained.

Ecological Investment Priority:

INTACT: This rock-hole site was in good condition with minimal threats noted.

Cultural Investment Priority:

HIGH: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 37. Looking towards the hill that the rock-hole exists on amongst a saltbush plain

Yardea Homestead

Feature	Name	Cultural access	Lease	Date visited
Rock-hole / Kapi Tjurkala	Yardea Homestead	Open	Yardea	1st July 2010

Site Description	Yardea Homestead
Feature	Granite outcrop in a creek line that had a series of headwater pools at the bottom of each waterfall. There was a stone constructed weir at the bottom in the narrowest and deepest part of the creek line. We also walked up a second creek line next to the main one with the weir.
Size / Area	Numerous pools in rocky creek line over ~300 m,
Conceptual understanding	These pools are not typical rock-holes and are situated in a rocky creek line. It is assumed that these pools are spring-fed during and after seasonal and episodic rainfall.
Recent inundation	16.8 mm was recorded for Kimba (25th June – 2nd July 2010) which had filled the rock-holes visited during the June 2010 fieldtrip.
Elevation	Ranging from 300 – 320 m.
Vegetation association	The hill slope was a *Triodia irritans* (Spinifex) hummock grassland.

Vehicle track description	Track Yes/No	Track Condition Good/Average/Bad	Access to site Easy/Difficult/Hard
Pastoral track access near the homestead but not directly to the site, ~200 m walk to the creekline.	No	-	Difficult

Figure 38. Stone wall weir in first creek line (left) and top of second creek line (right) behind Yardea Homestead.

Section 1 – Site Overview

Cultural Assessment and Evaluation				
Mythological	Access	Gender	Significance	Status
	Open	Both	Medium	Unrecorded
Archaeological	Observations			
	Scatters	Historical		

Qualitative / rapid survey of perennial species (annual weed species are included)				
	Species	**Common name**	**Aboriginal name**	**Aboriginal use**
Aquatic	*Cyperus sp.*	-	-	-
Grasses / forbs	**Carrichtera annua*	Wards Weed	-	-
	Cheilanthes sieberi	-	-	-
	Chenopodium melanocarpum	Black Crumbweed (2nd Creekline)	-	-
	Cymbopogon ambiguus	Lemon-scented Grass	Ilintji (P) (Y)	Medicine
	Isotoma petraea	Rock Isotome	Tjuntiwari (P) (Y) Wa̲nnga̲ti (P) (Y)	Narcotic, medicine
	**Marrubium vulgare*	Horehound	-	-
	Salsola kali	Roly-poly (2nd Creek line)	Tjilka̲la (P) (Y) Iriya (Y)	Grubs
	**Solanum nigrum*	Blackberry Nightshade	-	-
	Solanum petrophilum	Rock-Nightshade	Tjilka-tjilka (P) (Y)	Poisonous
	[1]*Triodia irritans*	Spinifex Porcupine Grass	Tjanpi (P) (Y)	Resin
Shrubs	*Acacia sp.*	-	-	-
	[3]*Acacia tarculensis*	Tarcoola Wattle	-	Seeds
	Bursaria spinosa	Blackthorn	-	-
	[2]*Dodonaea viscosa*	Narrow-leaved Hopbush	Tjininypa (P) (Y)	Branches retain leaves and are used for shelters, smoke for medicine
	Enchylaena tomentosa	Ruby Saltbush	Iwa̲tiwa̲ta (P) Malkakutjalpa (P) Wilpan-wilpanpa (P)	Fruit
	Eremophila alternifolia	Narrow-leaf Emubush	Irmangka-irmangka (P)	Medicine

			Taritjanpa (P)	
	Eremophila serrulata	Green Emubush	-	-
	Lycium australe	Australian Boxthorn (2nd Creek line)	-	-
	Rhagodia parabolica	Mealy Saltbush	-	-
	Senecio magnificus	Showy Groundsel	Liru-liru (P) (Y)	-
	Senna artemisioides	Silver Cassia	Karpil-karpilpa (P) Arapita (P) Inuntji (P) (fresh growth & flowers) Pilani (P) Punti (P) Untunu (P)	Medicine (leaves are boiled and are put into a cream for aches and pains) (K) Grubs
	Senna artemisioides var. ?zygophylla(NSW)	Punty Bush	-	-
Trees	*Pittosporum angustifolium*	Native Apricot	Alita (P) Kumpalypa (P)	Medicine (seeds grounded and used for a poultice)

* indicates exotic species. [1,2,3] indicates order of dominate species at site. Aboriginal names and uses in (K) Kokatha from field trip recordings; (P) Pitjantjatjara / Pitjantjatjara Yankunytjatjara from Latz (1995) and Kutsche and Lay (2003); (Y) Yankunytjatjara from Goddard and Kalotas (1988).

Section 2 – Ecosystem Values and Threats

Table 1. Ecosystem value and threat (see Table 2 for 'vale' description).

	Indicator	Value	Description	Confidence
1	**Plant diversity** (see species list in Section 1)	MODERATE - HIGH	***Aquatic:*** 1 emergent species (Sedge) ***Understory:*** 10 species ***Shrub:*** 12 species ***Canopy:*** 1 species	Qualitative Survey
2	**Habitat diversity** (geomorphic features)	LOW	***Shallow pool / pans:*** 6 pools, plus weir (no water behind weir due to leak in stone wall) in the main creek line. In the 2nd creek line there was 1 pool.	Qualitative Survey
3	**Hydrological value**	MODERATE	Seasonal and episodic (dependent upon rainfall)	Local Knowledge
4	**Salinity**	FRESH	Water quality wasn't tested, but based on other sampling at rock-holes it is assumed that the water was fresh from recent rainfall.	Local Knowledge
5	**Cultural site**	HIGH	Aboriginal: Yardea is Kokatha for 'sedge' European: Stone weir.	Local Knowledge
6	**Uniqueness**	HIGH	Ecological: Yes, only site that has been visited that had a sedge species and *Cymbopogon ambiguus* (Lemon Grass), indicating a wetter inundation regime compared to other sites.	Qualitative Survey
7	**Key aquatic refuge**	LOW - MODERATE	Two pools were sampled, a total of 15 species of aquatic invertebrates plus tadpoles of *Neobatrachus pictus*.	High: EPA identification
8	**Weeds**	PRESENT	**Carrichtera annua* (Ward's Weed) was dense on the foot slopes, but only moderately dense in the gullies **Marrubium vulgare* (Horehound) and **Solanum nigrum* (Black-berry Nightshade) were also present at the site.	Qualitative Survey
9	**Exotic animals**	ABSENT	None observed but goats are known to visit the site on occasion (Sandy Morris pers comm.).	Qualitative Survey
10	**Water abstraction**	PRESENT	Stone weir built at bottom of creek line, there are no rock pools below the weir and currently weir doesn't hold water due to a leak in the stone wall.	Local Knowledge
11	**Grazing pressure**	LOW	Grazing pressure is low due to minimal 'house' paddock sheep (<10 sheep). Sedges grazed most probably by Euros. After the 1996 fire, there was increased grazing due to green pick(including goats)	Qualitative Survey
12	**Dung / dead matter / algae buildup**	LOW	Some animal dung present in the rock-pools,	Qualitative Survey

Table 2. Key to the ecosystem 'values' listed in Table 1 above.

ECOSYSTEM VALUES							THREATS				
1	2	3	4	5	6	7	8	9	10	11	12
1 sp. for each strata (aquatic)	≥3 geomorphic features	Permanent	TDS <500 mg/L (fresh)	National Park, Aboriginal or European heritage	Only 'type' in catchment / rock outcrop	HCVAE / Ramsar / equiv.	Absent			Low	
1 sp. for each strata (non-aquatic)			TDS 500 – 3,000 mg/L (sub-saline)			Threatened (or equiv.) sp. present					
1 strata missing	2 geomorphic features	Seasonal	TDS 3,000 – 20,000 mg/L (Hypo-saline)	Infrastructure at site eg. pump	>1 type in catchment / rock outcrop	Refuge feature during droughts / cease to flow					
2 strata missing			TDS 20,000 – 50,000 mg/L (meso-saline)			Aquatic fauna present					
3 strata missing	1 geomorphic feature	Episodic	TDS > 50,000 mg/L (hyper-saline)	Stock watering point	>1 type in stream reach	Aquatic fauna absent	Present			High	

Section 3 – Site Condition

Table 3. Vegetation condition (see Table 4 for the description of the indictors and Table 5 for the attributes used to assess vegetation condition).

Indicator	Value	Description	Confidence
Spatial Integrity	LARGELY UNMODIFIED	No loss of native species.	Observation
Nativeness	MODERATELY MODIFIED	*Carrichtera annua* (Ward's Weed) was domiant at the site, *Marrubium vulgare* (Horehound) and *Solanum nigrum* (Black-berry Nightshade) were also present.	Observation
Structural Integrity	LARGELY UNMODIFIED	There are plant species in each stratum, the foliage cover across each strata being natural.	Observation
Age Structure	LARGELY UNMODIFIED	*Dodonaea viscosa* (Hopbush) and *Senna artemisioides* (Silver Cassia), had adults and sub-adults present, with foliage cover being natural.	Observation
Debris	LARGELY UNMODIFIED	Natural.	Observation

Table 4. Vegetation Condition Sub-Indices Attributes (for each indicator refer to appropriate row in Table 5 for assessment criteria).

Spatial Integrity: Width of riparian vegetation (as defined by inundation dependent species). Longitudinal continuity continuous cover of dominant stratum along the channel. Connectedness of the riverine vegetation to other areas of native vegetation (riparian or terrestrial).

Nativeness: Percentage of non-native and high impact species. Abundance of non-native and high impact species in different strata. (This project will focus on perennials due to the arid system; annual cover is determined by rainfall which can coincide with site visits).

Structural Integrity: Number of strata and/or life forms. Cover for each stratum.

Age Structure: Cover of canopy species. Presence (or abundance) of different age stages. Presence (or abundance) of large old trees.

Debris: Abundance of fallen logs. Presence (or abundance) of standing dead trees. Percentage cover of litter.

Table 5. Key to the ecosystem 'values' listed in Table 3 above.

	Largely Unmodified	Slightly Modified	Moderately Modified	Substantially Modified	Severely Modified
Spatial Integrity	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
Nativeness (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
Structural Integrity	Number of strata and cover within each strata is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland, shrubland, forest pasture)
Age Structure	Dominant strata with reference level of cover and at least three age classes present	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
Debris	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

Section 4 – Joint Management Considerations

Current Management:

The site is within the Yardea Homestead paddock. There are no grazing impacts at the site with less than 10 sheep in the paddock.

Restoration Potential:

INTACT: Maintain current land management practices.

Ecological Investment Priority:

INTACT: This spring site was in good condition with minimal threats noted. Further information regarding the possible significance of the sedge species is warranted as it hasn't been recorded at other sites during this survey.

Cultural Investment Priority:

INTACT: Culturally significant site with traditional management to be undertaken including regular visitation and rock-hole cleaning.

Site to be recorded and registered under the Aboriginal Heritage Act (1998).

Figure 39. Mel White (DFW) sampling for macro-invertebrates at one of the headwaters flowing along a rocky creek line near the Yardea Homestead.

CONCLUSION

Overall, most sites were assessed in good condition as largely unmodified. A summary of the 18 rock-holes assessed in the previous section are prioritised for this project in

Table 1. Two key prioritisation attributes (Investment Priority and Restoration Potential) have been taken from the individual site score-cards to summarise the important assets that the SAAL NRM Board can use to direct on-ground works. The methodology that determines the scoring of these attributes is discussed in Field Assessments Methods section. A third attribute (Diversity) has been added to the conclusion table in this section to help summarise the data behind the priorities. Even though diversity contributes towards the investment priority, a separate 'actual' measure of diversity taken from the number of plant species recorded at each site supports the other two priority rankings (Investment Priority and Restoration Potential).

Two sites were identified as having the highest ecological potential for management (

Table 1) and these sites are also very significant to the Aboriginal people. The sites were Pilleutta on Kokatha Station; an Aboriginal women's site that was rich in bush tucker and medicine, was in very good condition but is threatened by goat grazing. The other site was Bulpara Hill on Wilgena Station; an Aboriginal men's site that had a large diversity of shrub species with minimal population replacement observed. The main threats to the site were grazing of seedlings and shrubs by rabbits, goats and sheep.

There are three instances where there was a higher cultural investment priority than an ecological priority (Tandaie, Murnea and Tunkillia). These sites are culturally important but do not support a diverse and un-impacted ecosystem.

Future monitoring and investment of sites should consider each site assessment report as guidance on what needs to be monitored, it is also recommended that future monitoring sites should specify the monitoring question e.g. monitoring vegetation that is of cultural importance for a cultural reason rather than monitoring grazing which is currently done through the South Australian Pastoral Board. Other data that is also collected but has not been reported on is the size and depth of rock-holes. Future analysis could also be done using this data to investigate a measure of rock-hole permanency.

Table 1. Summary and comparison of investment priorities across the sites.

Lease	Site	Cultural Investment Priority	Ecological Investment Priority	Restoration Potential	Plant Diversity (# species)
Wilgena	Bulpara Hill	HIGH	HIGH	HIGH	19
Kokatha	Pilleutta	HIGH	HIGH	HIGH	26
Moonaree	Dingo Hill	HIGH	INTACT	INTACT	12
Koweridda	Koweridda OS/Yarunda	HIGH	INTACT	INTACT	14
Yardea	Kulkalla	HIGH	INTACT	INTACT	17
Thurlga	Tandaie	HIGH	MODERATE	MODERATE	9
Moonaree	Murnea	HIGH	MODERATE	MODERATE	11
North Well	Tunkillia	HIGH	LOW	MODERATE	7
Thurlga	Spring Hill	MODERATE	INTACT	INTACT	13
North Well	Arcoodaby	MODERATE	MODERATE	MODERATE	9
Wilgena	Darebin	INTACT	INTACT	INTACT	10
	Mullina	INTACT	INTACT	INTACT	16
Thurlga	Thurlga HS	INTACT	INTACT	INTACT	26
	Hudson's	INTACT	INTACT	INTACT	15
Yardea	Yardea HS	INTACT	INTACT	INTACT	24
	Artaming	INTACT	INTACT	INTACT	13
North Well	Tomato Camp	LOW	LOW	MODERATE	9
Wilgena	Moolkra Clay pan	LOW	LOW	LOW	3

In conclusion the following points must be considered:

- As the inventory is further increased to include more rock-holes, some attribute data may change which potentially could change the investment priority.
- The prioritisation schedule of the rock-holes should be reviewed and updated as additional information becomes available.
- It should also be noted that by nature, vegetation communities in the Rangelands have attributes of resistance (withstand disturbance) and resilience (recover from disturbance) although it must be understood that rehabilitation of Rangeland ecosystems occurs over decades, especially if long dry periods persist.
- Long-term success of these rehabilitation projects in rangeland ecosystems need both financial and land management support.

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APPENDIX

Table 2. Aquatic Invertebrates collected at sites within the Gawler Ranges during the June 2010 field-trip.

Aquatic Invertebrate				Yardea				Thurlga		Moonaree
Major Group	Subclass	Family	Taxon	Homestead 69	Homestead 71	Artaming	Kulkalla	Hudson's	Tandaie	Dingo Hill
MOLLUSCA	.	Physidae	*Physa sp	.	.	.	.	.	2	.
ARACHNIDA	.	Eylaidae	Eylais sp.	.	.	.	.	2	.	.
CRUSTACEA	Cladocera	Chydoridae	?Leydigia sp.	.	.	.	.	.	3	
	Cladocera	Daphniidae	Daphnia carinata	88	9	.	7	.	2	10
	Ostacoda	?Cyprididae	green valves	.	11	5	20	2	88	40
	Ostacoda	?Cyprididae	beige valves	4	5	5	.	14	5	4
	Conchostraca	Lyncaeidae	Lynceus sp.	3	3	.	1	.	11	.
	Copepoda	Centropoagidae	Calanoida sp.	.	1	.	.	34	.	.
	Copepoda	Cyclopoidae	Cyclopioda sp.	.	.	.	.	1	.	.
INSECTA	Beetles	Dytiscidae	Allodessus (larvae)	.	2	.	3	.	1	.
	Beetles	Dytiscidae	A. bistrigatus	.	2	1	.	1	.	.
	Beetles	Dytiscidae	Copelatus (larvae)	.	1	.	.	.	.	.
	Midges	Chironomidae	Cricotopus sp.	.	1	1	.	.	.	.
	Midges	Chironomidae	Paratrichocladius sp.	.	1	.	.	.	.	.
	Midges	Chironomidae	Chironomus sp.	.	.	.	.	.	1	3
	Midges	Chironomidae	Orthoclad (small)	.	.	1	.	.	.	.
	Midges	Chironomidae	Botryocladius sp.	3	.	.	.	.	.	.

	Midges	Chironomidae	?Gymnometricnemus/Allotrissocladius complex	1	.	.	.	.	.	.
	Biting midges	Ceratopogonidae	Culicoides sp.	.	1	.	.	.	.	.
	Mosquitoes	Culicidae	Aedes camptorhynchus	.	.	1	.	.	.	.
	Mosquitoes	Culicidae	Aedes alboannulatus	1	.	.	.	.	.	.
	True Bugs	Corixidae	Agraptocorixa sp.	.	.	.	.	.	1	.
	True Bugs	Corixidae	A. parvipunctata	.	.	.	.	1	.	.
	True Bugs	Notonectidae	Anispos sp. (females)	1	1	.	.	.	.	.
FROGS		Leptodactylidae	Neobatrachus pictus (tadpoles)	1	.	.	.	.	1	.

*denotes an introduced species.