Department of
Environment and Conservation

Our environment, our future

Resource Condition Report for a Significant Western Australian Wetland

Lake Ballard

2009

Figure 1 – A view across the lake floor at Lake Ballard.

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Contents

1. Introduction

This Resource Condition Report (RCR) was prepared by the Inland Aquatic Integrity Resource Condition Monitoring (IAI RCM) project. It describes the ecological character and condition of Lake Ballard, a very large intermittent saline lake in Western Australia's Murchison bioregion.

Lake Ballard was selected as a study site in the IAI RCM project due to its recognition as a nationally important wetland by being listed in *A Directory of Important Wetlands in Australia* (DIWA) (Environment Australia 2001). It has also been nominated for listing as a Ramsar wetland, as it meets three criteria for a Wetland of International Importance (Jaensch and Watkins 1999). Lake Ballard is one of the most important breeding sites in Australia for the endemic Banded Stilt (*Cladorhynchus leucocephalus*) (Handley 1996) and is an important migration stopover for many other species of waterbird.

1.1. Site Code

Directory of Important Wetlands in Australia: WA058.

Register of the National Estate Indicative Place ID: 102194.

Inland Aquatic Integrity Resource Condition Monitoring Project (DEC): RCM016.

1.2. Purpose of Resource Condition Report

The objective of the RCR is to summarise all available ecological information relevant to Lake Ballard and describe the drivers of, and threats to, the system. This 'snapshot' of ecological character will provide context for future monitoring of the site and allow the effectiveness of management planning and actions to be assessed.

1.3. Relevant International Agreements and Legislation

The following is a summary of international agreements and legislation that may be relevant to the management of Lake Ballard.

International

Migratory bird bilateral agreements and conventions

Australia is party to a number of bilateral agreements, initiatives and conventions for the conservation of migratory birds that may be relevant to Lake Ballard. The bilateral agreements are:

JAMBA - The Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment, 1974.

CAMBA - The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment, 1986.

ROKAMBA - The Agreement between the Government of Australia and the Republic of Korea for the Protection of Migratory Birds and their Environment, 2006.

The Bonn Convention on Migratory Species (CMS) - The Bonn Convention adopts a framework in which countries with jurisdiction over any part of the range of a particular species co-operate to prevent migratory species becoming endangered. For Australian purposes, many of the species are migratory birds.

Convention on Wetlands (Ramsar) - Australia a signatory to the Ramsar Convention, an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Lake Ballard is proposed for listing under the Ramsar Convention, so this convention may be relevant in the future.

National legislation

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. These are defined in the Act as matters of national environmental significance.

There are seven matters of national environmental significance to which the EPBC Act applies; two of these are relevant to Lake Ballard:

- nationally threatened species and ecological communities; and
- migratory species listed under international treaties JAMBA, CAMBA and CMS.

Lake Ballard is also a proposed Ramsar site and, if this listing is achieved, the site will be further protected under the EPBC Act as a wetland of international significance.

Australian Heritage Council Act 2003

Lake Ballard has been placed on the Register for National Estate (indicative place). Indicative placement on the Register for National Estate means that data has been provided to or obtained by the Australian Heritage Council or the former Australian Heritage Commission for Lake Ballard and has been entered into their database. However, the site is in the assessment process and a decision on whether the place should be entered in the Register has not been made. The Australian Heritage Council can no longer add places to or remove places or a part of a place from the Register of the National Estate (as of February 2007). Hence, Lake Ballard currently is not offered protection under the *Australian Heritage Council Act 2003.*

Western Australia legislation

Wildlife Conservation Act 1950

This Act provides for the protection of wildlife. All fauna (animals native to Australia) in Western Australia is protected under section 14 and all flora (plants native to Western Australia) are protected under section 23 of the *Wildlife Conservation Act 1950*. The Act establishes licensing frameworks for the taking and possession of protected fauna, and establishes offences and penalties for interactions with fauna.

Aboriginal Affairs Planning Authority Act 1972 (AAPA Act)

The AAPA Act repealed earlier Indigenous welfare legislation. It governs most Indigenous land related matters and vests reserves in the Aboriginal Affairs Planning Authority, which promotes the well-being and economic advancement of Indigenous Australians. A visitor should always seek and gain permission to enter an Aboriginal community, and in the case of Aboriginal Reserve land, must do so by obtaining an entry permit. Under the AAPA Act, transit permits are required for any person visiting or passing through an Aboriginal reserve, unless he/she is:

- a person of Aboriginal descent;
- a member of either House of Parliament of the State or of the Commonwealth;
- a person exercising a function under the AAPA Act 1972 or otherwise acting in pursuance of a duty imposed by law; or
- a person authorised under the regulations of the AAPA Act 1972.

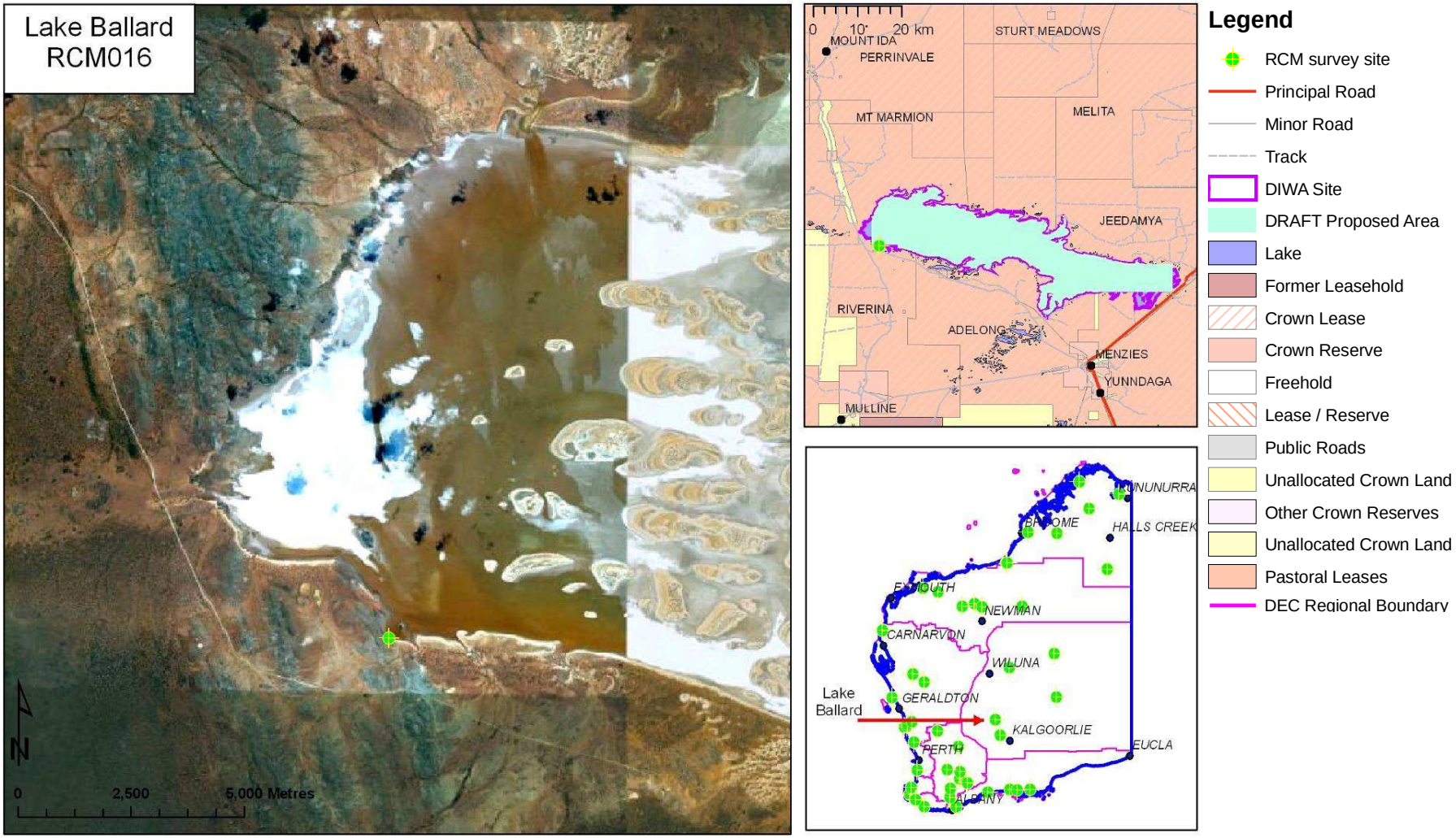

Figure 2 – Aerial photograph showing the location of the survey location at Lake Ballard. The upper insert shows the nature of surrounding tenure and the extent of the DIWA and proposed Ramsar listed areas. The lower insert shows the location of the lake in Western Australia and its location in proximity to other RCM survey sites.

2. Overview of Lake Ballard

2.1. Location and Cadastral Information

Lake Ballard lies approximately 20 km north of Menzies and immediately west of the Goldfields Highway (Figure 2). It is elongated along an east-west axis and is approximately 60 km in length and 15 km in width. The lake lies predominantly on Unallocated Crown Land and on leasehold land used for pastoralism (Jeedamya, Riverina, Kookynie, Melita and Adelong pastoral stations). The southern margin of Lake Ballard is partially contained within Marmion Aboriginal Reserve. Surrounding land is used for pastoralism (sheep grazing), mineral exploration and gold mining (Lynch 1995).

2.2. IBRA Region

Lake Ballard is within the eastern subregion (MUR1) of the Murchison Interim Biogeographic Regionalisation of Australia (IBRA) region. This region comprises the northern parts of the 'Southern Cross' and 'Eastern Goldfields' terrains of the Yilgarn Craton. It is characterised by its internal drainage and extensive areas of elevated red desert sandplains with minimal dune development. The region also contains several salt lake systems, such as Lake Ballard, associated with the occluded palaeodrainage system. The vegetation consists primarily of Mulga woodlands often rich in ephemerals, hummock grasslands, saltbush shrublands and *Halosarcia* spp. shrublands (Cowan 2001).

2.3. Climate

The nearest Bureau of Meteorology weather station to Lake Ballard is at Menzies (approximately 20 km southeast of Lake Ballard), where records have been kept since 1896 (Bureau of Meteorology 2009). Menzies experiences an arid climate; it receives a mean annual rainfall of 250 mm, mostly falling in the first half of the year (Figure 3). Rainfall is unreliable and highly variable, being associated with decaying tropical cyclones in summer and cold fronts in winter. Summers are very hot and winters cold, with minima/maxima peaking in January at 19.1 ºC/35.1 ºC and dropping to 5.3 ºC/17.0 ºC in July. Annual evaporation is approximately 3,200 mm, meaning the rate of evaporation in the area exceeds the rate of precipitation by between 10 and 15 times. This has a large influence on the duration of inundation of Lake Ballard (Handley 1996).

Lake Ballard was surveyed by the IAI RCM project on the 19th of August 2008. In the six months preceding the survey, Leonora (the nearest town to Lake Ballard) received 122 mm of rain. The majority of this (78.8 mm) fell in February. No rain was recorded in the first nineteen days of August.

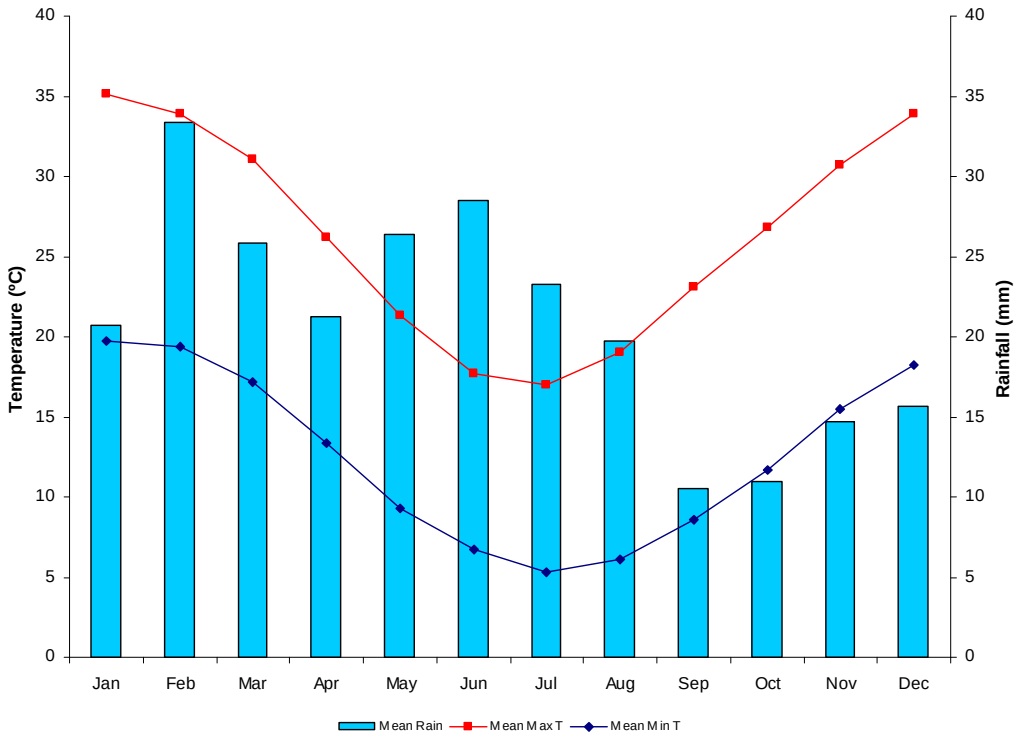

Figure 3 – Climatic averages for Menzies, approximately 20 km southeast of Lake Ballard.

2.4. Wetland Type

The Directory of Important Wetlands in Australia (Environment Australia 2001) describes Lake Ballard as a seasonal/intermittent saline lake (type B8). Lake Ballard is an intermittent saline lake and is a megascale irregular elongate sumpland with numerous micro to macroscale islands (Lynch 1995).

2.5. Directory of Important Wetlands in Australia Criteria

Lake Ballard is designated as a wetland of national importance under criteria 1, 3 and 4 of the Directory of Important Wetlands in Australia. These criteria are as follows:

1. *It is a good example of a wetland type occurring within a biogeographic region in Australia.* It is a good example of an intermittent saline lake of the Murchison bioregion.

3. *It is a wetland that is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.* The lake is an internationally important migration stopover area for Great Egrets (*Ardea alba*). It is also used as breeding grounds for three species: Banded Stilt (*Cladorhynchus leucocephalus*), Red-capped Plover (*Charadrius ruficapillus*) and Red-necked Avocet (*Recurvirostra novaehollandiae*).

4. *The wetland supports 1% or more of the national populations of any native plant or animal taxa*. It provides habitat for the endemic Banded Stilt. Tens of thousands of individuals were present in 1995, exceeding 1% of the estimated national population (Lynch 1995).

2.6. Values of Lake Ballard

Values are the internal principles that guide the behaviour of an individual or group. Value systems determine the importance people place on the natural environment and how they view their place within it. Divergent values may result in people pursuing different objectives in relation to nature conservation, having different reasons for desiring a commonly agreed outcome, or favouring different mechanisms to achieve it. Because of this, it is important to be explicit about the values that are driving conservation activities at a wetland.

The Conceptual Framework for Managing Natural Biodiversity in the Western Australian Wheatbelt (Wallace 2003) identified eight reasons that humans value natural biodiversity:

a. Consumptive use

Consumptive use is gaining benefit from products derived from the natural environment, without these products going through a market place, for example, the collection and personal use of firewood or 'bushtucker'. Jenkins (1975) reported that Aborigines regarded Banded Stilt chicks as a delicacy and were attracted to the Lake Ballard area when nesting took place in 1973. There was no indication of Aboriginal visits to nesting colonies in 1995 (Lynch 1995) nor in 2008. It appears that very little consumptive use is currently made of the lake.

b. Productive use

Productive use values are derived from market transactions involving products derived from the natural environment. The same firewood that is collected for personal use may be exchanged for money or another commodity. While it is likely local Aboriginal derived productive uses from Lake Ballard historically, the lake supports no known productive use values in the present day.

c. Opportunities for future use

Not all uses of the natural environment may be apparent at present. The potential for future benefit from the natural environment is maximised by maintaining the greatest possible biodiversity. Every lost taxa or ecosystem represents lost opportunities. Lake Ballard may support endemic or rare taxa. Such unique features would increase the potential for future opportunities to present.

d. Ecosystem services

There are many naturally occurring phenomena that bring enormous benefit to mankind. For instance, plants generate oxygen, insects pollinate food crops and wetlands mitigate floods by regulating water flows. The term 'ecosystem services' is used as a broad umbrella to cover the myriad of benefits delivered, directly or indirectly, to humankind by healthy ecosystems. Lake Ballard contributes significantly to the biodiversity of the region by providing a migration stopover for the Great Egret and breeding grounds for three waterbird species. Lake Ballard is one of the most important breeding sites in Australia for the endemic Banded Stilt and has been known to support enormous numbers of this species. It may also play a role in regional hydrology.

e. Amenity

Amenity describes features of the natural environment that make life more pleasant for people. For instance, pleasant views and shade or wind shelter from a stand of trees. It is difficult to quantify the amenity value of a site such as Lake Ballard, but it is certainly valued by the local community for the amenity it provides. This has been the case particularly since 2003, when the "Inside Australia" art exhibition was installed at Lake Ballard (see 'Recreation').

f. Scientific and educational uses

Parts of the natural environment that remain relatively unmodified by human activity represent great educational opportunities. Such sites allow us to learn about the changes that have occurred to the natural world. They are also 'control' sites that allow us to benchmark other, altered habitats. Lake Ballard presents opportunities for studying Banded Stilts, particularly their life history. A detailed study was conducted by the Department of Conservation and Land Management (now Department of Environment and Conservation) of the Banded Stilt breeding event in 1995 when Lake Ballard was filled by Cyclone Bobby. The study resulted in long-term monitoring of the movements of birds that were flagged and ringed (Lynch 1995).

g. Recreation

Many recreational activities rely on the natural environment (bird watching, canoeing, wildflower tourism, etc.) or are greatly enhanced by it (hiking, cycling, horse riding, photography, etc.). Recreation may deliver economic benefit derived from tourism and also delivers spiritual and physical health benefits to the recreator. Lake Ballard became a unique recreational site in 2003, when British sculptor Antony Gormley installed fifty-one steel statues on the lakebed as part of the Perth International Arts Festival (PIAF). The internationally recognised sculptures (Figure 4) have transformed the lake into an art gallery, providing a tourist attraction and countless opportunities for photographers. The sculptures have been described as an "incredible cultural display situated on an eerie setting on a salt lake" (Rydges 2008) and were considered such a success that the installations were not dismantled when PIAF ended and are now a permanent fixture (Sutton 2007).

Figure 4 – A night-time view of one of Antony Gormley's fifty-one statues at Lake Ballard.

h. Spiritual/philosophical values

People's spiritual and philosophical reasons for valuing the natural environment are numerous and diverse. One commonly cited is the 'sense of place' that people derive from elements of their environment. This is evident in many Aboriginal and rural Australians, who strongly identify themselves with their natural environment. Many people also believe that nature has inherent value or a right to exist that is independent of any benefit delivered to humans. A sense of spiritual well-being may be derived from the knowledge of healthy environments, even if the individual has no contact with them. It is possible that cultural values, both indigenous and non-indigenous, may exist at Lake Ballard. As yet, the Australian Heritage Council has not assessed these values (Handley 1996).

The intent of nature conservation is usually to maintain the ecosystem service values, opportunity values and scientific and educational values at a given site. Doing so is likely to have positive effects on the amenity values, recreational values and spiritual/philosophical values to which the site's natural environment contributes. Consumptive and productive uses of the natural environment are not usually considered, as these are often incompatible with nature conservation.

3. Critical Components and Processes of the Ecology of Lake Ballard

The objective of the Lake Ballard Resource Condition Report (RCR) is to identify, describe and quantify the components and processes that drive the wetland ecosystem. These components and processes determine the site's ecological character and are the variables that should be addressed in any ongoing monitoring.

Climate and geomorphology are the most important drivers of wetland ecosystems. Between them, these factors determine the position of a wetland in the landscape and the type and hydrological regime of that wetland. In turn, a wetland's position, type and hydrology exert a strong influence on its biota and biochemical properties and processes.

A summary of Lake Ballard's critical ecosystem components is presented in Table 1. This is followed by a detailed description of the results of the Inland Aquatic Integrity Resource Condition Monitoring (IAI RCM) 2008 survey, as well as findings from previous studies conducted on the wetland.

Table 1 – Summary of critical ecosystem components at Lake Ballard.

Component	Summary description
Geomorphology	Macroscale irregular sumpland situated in the Yilgarn Craton, part of an ancient dry river valley; lacustrine and alluvial valley-fill deposits
Hydrology	Episodic inundation; hydrology sustained mainly by direct precipitation but also episodic surface inflow from creeks
Water Quality	Hypersaline; poikilohaline
Benthic Plants	None
Littoral Vegetation	Samphire fringing the lake and on islands; Eucalypt woodlands on gypsum dunes and islands
Invertebrates	Brine shrimp abundant when lake is inundated
Fish	No validated reports
Waterbirds	Twelve species recorded, including one migratory and three breeding
Terrestrial Vertebrates	Nineteen species of reptile and two frog species have been recorded in the vicinity of Lake Ballard

3.1. Geology and Soils

Lake Ballard is situated in the Yilgarn Craton on lacustrine and alluvial valley-fill deposits. The lake forms part of a palaeodrainage system (an ancient dry river valley), which drained to the southeast connecting through Lake Marmion to Lake Rebecca and Ponton Creek when the rivers were functional in the late Cretaceous to early Tertiary periods (Lynch 1995; Handley 1996).

3.2. Hydrology

Lake Ballard is located in the Raeside-Ponton Catchment. The lake fills episodically, from direct precipitation and episodic surface inflow from creeks. Inundation probably occurs once every five years on average, usually due to a single major summer-autumn rain event of tropical origin. The

lake has a maximum recorded depth of 0.5 m (in 1995, 0.3 m in 1975) and water may persist for six to nine months after inundation (Lynch 1995).

3.3. Water Quality

Lake Ballard was dry at the time of sampling by the IAI RCM project. Therefore, no water quality data were collected.

Lake Ballard has previously been described as hypersaline and poikilohaline. It experiences substantial changes in surface water salinity coinciding with the lake's drying cycle. Lake Ballard ranges from almost fresh when initially inundated, to hypersaline when almost dry (Lynch 1995; Handley 1996).

The pH of Lake Ballard was 8.0 in 1995 (Lynch 1995). The water's colour ranges from red-brown when windy, owing to the red soils characteristic of the area, to clear when the lake is calm (Lynch 1995).

3.4. Benthic Plants

Lake Ballard was dry at the time of sampling by the IAI RCM project so no benthic plants were recorded. However, aquatic plants would not be expected due to the lake's high salinity.

3.5. Littoral Vegetation

Although no vegetation occurs on the lakebed, the islands and lake margins support low shrubland consisting of samphire communities (including *Halosarcia* spp.). The surrounding areas support open-scrub. *Eucalyptus striaticalyx* woodlands grow on the gypsum dunes and islands, sometimes with the unusual Dunna Dunna (*Lawrencia helmsii*). The northern perimeter of the lake is dominated by low shrubland comprised mainly of the succulents saltbush (*Atriplex* sp.) or bluebush (*Maireana* spp.) with scattered low trees and shrubs of mulga (*Acacia aneura*) and wattles (*Acacia* spp.). To the west and south of Lake Ballard are areas of mulga low woodland with some *Casuarina pauper* (Beard 1976; Lynch 1995).

The IAI RCM project established a single vegetation transect in the samphire dominated community that fringes the lakebed (Table 2). Low dunes dominated by *Atriplex* sp. and *Frankenia* sp. occurred beyond the samphire zone. Substantial erosion of these dunes was evident (Figure 5). Further from the lake's edge, *Acacia aneura* woodland was extensive.

Figure 5 –Eroded dunes on the western end of Lake Ballard, dominated by *Atriplex* sp and *Frankenia* sp. Behind this is samphire dominated vegetation, typical of the area where the vegetation transect was established. *Acacia aneura* woodland is visible in the background.

Table 2 – Site attributes of the Lake Ballard vegetation transect.

Datum			WGS84
Zone			51
Easting			267491
Northing			6739990
Length			30 m
Bearing			280
Wetland state			Dry
Soil state (%)		dry	0
		waterlogged	100
		inundated	0
Substrate (%)	Observed	bare	20
		rock	0
		cryptogam	0
		litter	5
		trash	0
		logs	0
	Expected	bare	20
		rock	0
		cryptogam	0
		litter	5
		trash	0
		logs	0
Time since last fire			no evidence
Community condition			natural
Upper Stratum		Cover (%)	-
		Height (m)	-
Mid Stratum		Cover (%)	-
		Height (m)	-
Ground Cover		Cover (%)	50.2
		Height (m)	0.4

The vegetation transect (Figure 6) was established approximately 50 m from the lake's edge. The clayey soils were waterlogged beneath the surface at the time of survey. The transect vegetation consisted of a single stratum of *Tecticornia laevigata*, *T.* sp., *T. undulata* low chenopod shrubland (50.2% cover, 0.4 m tall).

Approximately 25% of *Tecticornia* spp. individuals were dead at the time of survey and no recruitment was recorded. The site has been affected by tourists walking from the car park to the lake floor, but community condition was otherwise considered 'natural' (Table 8 in Appendix 1).

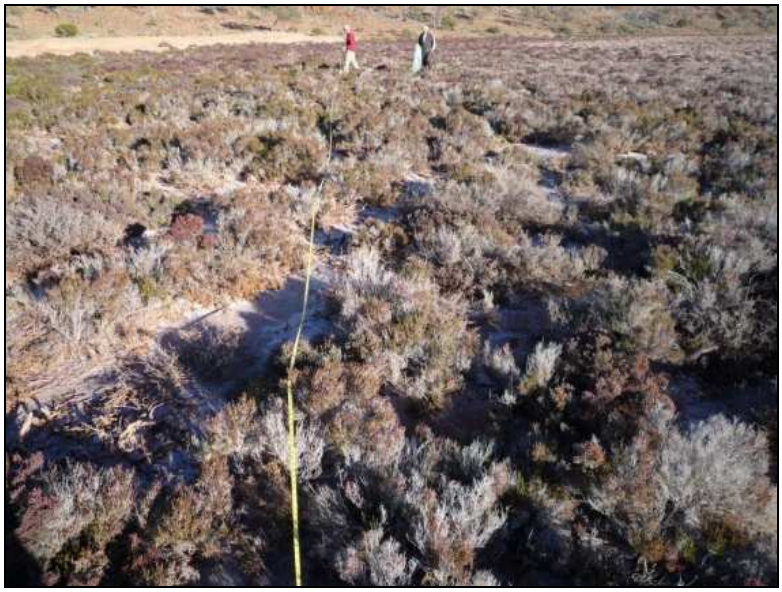

Figure 6 – Lake Ballard vegetation transect.

Table 3 – Plant taxa recorded along the vegetation transect at Lake Ballard (in order of dominance).

Genus	Species	Height (m)	Stratum[1]	Form
Tecticornia	*laevigata*	0.4	G1	Chenopod
Tecticornia	sp.	0.4	G1	Chenopod
Tecticornia	*undulata*	0.3	G1	Chenopod

1 In an NVIS description, 'U' denotes the upper storey, 'M' the mid storey and 'G' the under storey (ground cover). Numerals to denote substrata from tallest (ESCAVI 2003).

According to the National Vegetation Information System (NVIS), the vegetation community may be described as (ESCAVI 2003):

G1+ ^*Tecticornia laevigata*, *Tecticornia* sp., *Tecticornia undulata*\^samphire shrub\1\c.

3.6. Invertebrates

Lake Ballard was dry at the time of survey by the IAI RCM project. Therefore, no aquatic invertebrates were collected. Brine shrimps (*Parartemia sp.*) have previously been recorded as abundant when the lake fills. Brine shrimp are the main food of Banded Stilt adults and chicks (Lynch 1995; Handley 1996).

Terrestrial invertebrates, such as two species of beetle (*Megacephala oleadorsa and M. blackburni*) and one species of spider (*Lycosa alteripa*), have also been collected from the lake (Lynch 1995; Handley 1996). The wolf spider, *L. alteripa*, is one of three species of spiders endemic to the surface of normally dry salt lakes. All three species excavate burrows in the lake surface, affording protection from predators and enabling the maintenance of a more suitable microclimate within which to live (Hudson and Adams 1996).

3.7. Fish

No fish were observed during the 2008 IAI RCM survey, as Lake Ballard was dry at the time.

'An abundance of small fish brine shrimps' was reported to have been observed in the lake in April 1975. However, there have been no other reports of fish (Kolichis 1976). They were possibly dytiscid beetles (A. Chapman pers. comm. in Lynch 1995).

3.8. Waterbirds

No waterbirds were observed during the 2008 IAI RCM survey as Lake Ballard was dry at the time.

Twelve species have previously been recorded at Lake Ballard (Table 4), including Great Egret - a migratory species listed under international treaties (see Section 1.3), and Hooded Plover, which are rare in Australia. Four species have also been found breeding at Lake Ballard (Lynch 1995; Chapman and Lane 1997).

Table 4 – Waterbirds previously observed at Lake Ballard.

Common name	Latin name
Australian Shelduck	*Tadorna tadornoides*
^ Banded Stilt	*Cladorhynchus leucocephalus*
Black Swan	*Cygnus atratus*
* Great Egret	*Ardea alba*
^ Grey Teal	*Anas gracilis*
Hooded Plover	*Thinornis rubricollis*
Pacific Black Duck	*Anas superciliosa*
^ Red-capped Plover	*Charadrius ruficapillus*
^ Red-necked Avocet	*Recurvirostra novaehollandiae*
Silver Gull	*Larus novaehollandiae*
Straw-necked Ibis	*Threskiornis spinicollis*
White-faced Heron	*Egretta novaehollandiae*

* Listed under Migratory Bird Agreements JAMBA, CAMBA and ROKAMBA
^ Recorded breeding

Lake Ballard is one of the most important breeding sites in Australia for the endemic Banded Stilt. Breeding has been recorded on a number of occasions and probably occurs whenever water depth over most of the lake reaches 0.3 m or more (Jenkins 1975; Kolichis 1976; Lynch 1995). Lake Ballard is an important site for the study of the breeding behaviour of the Banded Stilt (Handley 1996). Nests are prepared, typically 10 per m^2, on small low islets in colonies of hundreds to tens of thousands. At least six widely spaced islets, and possibly the shoreline, have been used for breeding. Eggs may be laid within weeks of the lake filling. Parties of attended non-flying young roam the lake, mainly downwind of nest sites, and thousands of chicks may trek tens of kilometres overland if lake conditions become adverse (too shallow/saline) (Lynch 1995). Red-capped Plover and Red-necked Avocet have also been found breeding on the islets in small numbers (Lynch 1995).

In its freshwater phase, Lake Ballard provides both breeding habitat for waterfowl and adequate food resources to sustain breeding. As such, Lake Ballard contributes significantly to the biodiversity of the region (Handley 1996).

Hoary-headed Grebe (*Poliocephalus poliocephalus*), Grey Teal, Musk Duck (*Biziura lobata*), Pink-eared Duck (*Malacorhynchus membranaceus*) and Eurasian Coot (*Fulica atra*) have been recorded breeding in a peripheral freshwater lake (Lynch 1995).

Breeding events attract large numbers of birds to Lake Ballard. Tens of thousands of Banded Stilt were present in 1995, exceeding 1% of the estimated national population. Thousands of Grey Teal and hundreds of Australian Shelduck were also observed at the lake in July 1995 (Lynch 1995).

3.9. Terrestrial Vertebrates

A Peregrine Falcon (*Falco peregrinus*) was observed preying on Banded Stilt chicks in 1995. There was also an unconfirmed report of an adult Night Parrot (*Pezoporus occidentalis*) and five

young in a nest on a spinifex flat in breakaway country (between the south-eastern shore of Lake Ballard and Ghost Rocks, 4 km distant) in 1937 (Jenkins 1975; Lynch 1995).

Nineteen species of reptile and two frog species have been recorded in the vicinity of Lake Ballard (Table 5).

Table 5 – Western Australian Museum records for fauna collected within 5 km of Lake Ballard (WA Museum 2009).

Scientific Name	Common Name	Year
Ctenophorus caudicinctus	Ring-tailed Dragon	1975
Ctenophorus salinarum	Claypan Dragon	2001
Ctenophorus scutulatus	Lozenge-marked Dragon	1996
Ctenotus schomburgkii	Barred Wedgesnout Ctenotus	1984
Diplodactylus pulcher	Fine-faced Gecko	
Egernia depressa	Pygmy Spiny-tailed Skink	
Heteronotia binoei	Bynoe's Gecko	2001
Lerista picturata	Southern Robust Slider	2000
Menetia greyii	Common Dwarf Skink	2000
Morethia butleri	Woodland Morethia Skink	1996
Neelaps bimaculatus	Black-naped Snake	
Neobatrachus centralis	Trilling Frog	1987
Neobatrachus kunapalari	Kunapalari Frog	1987
Pseudonaja nuchalis	Gwadar (Western Brown Snake)	1987
Pygopus nigriceps	Hooded Scaly-foot	1984
Ramphotyphlops australis	Southern Blind Snake	
Ramphotyphlops bicolor	Bicoloured Blind Snake	2000
Ramphotyphlops bituberculatus	Prong-snouted Blind Snake	
Simoselaps bertholdi	Jan's Banded Snake	
Underwoodisaurus milii	Thick-tailed Gecko	
Varanus gouldii	Gould’s Goanna	

4. Interactions between Ecological Components at Lake Ballard

An appreciation of the interactions between the elements of a wetland ecosystem is essential to understanding the condition of the system. Although components of a wetland are often monitored and managed as discrete entities, they exist as nodes in a complex ecological web. Documenting the full extent of the interactions that occur at a wetland would be impractical. However, it is essential to identify key interactions that define the system’s ecological character.

Hale and Butcher (2007) justified the equivalence of Ramsar nomination criteria and primary determinants of ecological character. Accordingly, the primary determinants of ecological character at Lake Ballard are:

- The characteristics that make the site a good example of a wetland type occurring within a biogeographic region in Australia.
- The animal taxa that utilise the site as habitat at a vulnerable stage in their life cycles, or as a refuge when adverse conditions such as drought prevail; and the characteristics of the site that allow it support these populations.

- The plant or animal taxa that have more than 1% of their national populations supported by the site and the habitat that supports them.

Table 6 summarises the interactions between key components and processes at Lake Ballard. The table lists the components that are directly responsible for the provision of each service or benefit of the wetland and the biotic and abiotic factors that support or impact these components. Also listed are the key threats that may affect the components or processes. This information assists in the identification of the primary determinants of ecological character.

Table 6 – The relationship between the services and benefits delivered by Lake Ballard and the key components and processes that support them.

Benefit or Service	Component	Factors Influencing Component		Threats and Threatening Activities
		Biotic	Abiotic	
Consumptive Value Aboriginal food source (hunting)	Banded Stilt chicks	Aquatic invertebrates and phytoplankton (food source) Vegetation communities (habitat and nesting sites)	Hydrological regime Water quality Geomorphology (islands on lake) Soils	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Predation by introduced fauna Erosion Overexploitation
Opportunity Value Potential future use of unique flora and fauna	Endemic flora Endemic fauna	Pollinators Food sources	Habitat extent and distribution Hydrological regime Fire regime Water quality	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Predation by introduced fauna Erosion
Ecosystem Service Value It is a good example of a wetland type occurring within a biogeographic region in Australia	A good example of an intermittent saline lake in the Murchison bioregion	Vegetation communities	Hydrological regime Water quality Geomorphology	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Erosion
Ecosystem Service Value It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail	Migrating Great Egrets Breeding Banded Stilt, Red-capped Plover and Red-necked Avocet	Aquatic invertebrates and phytoplankton (food source) Vegetation communities (habitat and nesting sites)	Hydrological regime Water quality Geomorphology (islands on lake) Soils	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Predation by introduced fauna Erosion Loss of migratory bird populations due to offsite factors

Benefit or Service	Component	Factors Influencing Component		Threats and Threatening Activities
		Biotic	Abiotic	
Ecosystem Service Value The wetland supports 1% or more of the national populations of any native plant or animal taxa	Banded Stilt	Aquatic invertebrates and phytoplankton (food source) Vegetation communities (habitat and nesting sites)	Hydrological regime Water quality Geomorphology (islands on lake) Soils	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Predation by introduced fauna Erosion
Scientific/Educational Value Banded Stilt monitoring	Banded Stilt	Aquatic invertebrates and phytoplankton (food source) Vegetation communities (habitat and nesting sites)	Hydrological regime Water quality Geomorphology (islands on lake) Soils	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Predation by introduced fauna Erosion
Recreational Value Bird watching Art appreciation Photography	Landscape amenity Waterbird populations Vegetation communities Significant flora Significant fauna Art installation (statues)	Aquatic invertebrates and phytoplankton (food source) Vegetation communities (habitat and nesting sites)	Hydrological regime Water quality Geomorphology (islands on lake) Soils	Altered hydrology due to climate change, water extraction or catchment perturbation Overgrazing by introduced and native fauna Weeds Predation by introduced fauna Erosion Loss of migratory bird populations due to offsite factors Tourists driving on the lakebed

5. Threats to the Ecology of Lake Ballard

The ambition for management at Lake Ballard is to maintain those elements of the ecology that resulted in its nomination as a DIWA site. The critical components of the ecology are the geomorphologic, hydrologic and water quality factors that make the lake a suitable stopover for migratory birds and a breeding site for domestic waterbirds. These factors are the primary determinants of the lake's ecological character. They are influenced by, and exert an influence on, the vegetation communities that surround the water body, the aquatic invertebrate communities that inhabit it and the threatening processes that face all of these. Also of importance are the elements of the system that contribute to its cultural and scientific value. These are the same as the above listed influences on the primary determinants of ecological character, with the addition of landscape amenity.

Threats to Lake Ballard must be considered in relation to their likelihood of causing failure of the above management goal for the lake. An assessment of each threatening process was conducted to assess the probability that goal failure would result as a consequence of each particular threatening process. The results of this assessment are presented in Table 7. In summary, failure to achieve the management goal for Lake Ballard is most likely to occur as a result of introduced fauna. The impacts here are twofold: predation of the bird population by feral carnivores and impacts on vegetation and soil structure from livestock and other herbivores. Mining is another significant threat to the area, with an economic nickel deposit beneath the lake currently being investigated for exploitation. Overall Lake Ballard's condition has been described as fair, with recovery requiring significant management interaction (Cowan 2001).

Feral animals

Feral animals have been identified as the primary threat facing Lake Ballard (Cowan 2001). In particular, introduced predators such as foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) prey on Banded Stilt chicks and eggs when water levels are low (Jenkins 1975). This could potentially affect the wetland's status as a major breeding ground for Banded Stilt. There are no feral predator control programs in place in the Murchison region (Cowan 2001).

Grazing, particularly by rabbits, occurs in the immediate vicinity of Lake Ballard but this currently has only a minor impact on the values of the system. Grazing does present a potential source of degradation since the lake's peripheral chenopod vegetation is highly preferred for grazing by introduced and native animals, rendering it susceptible to overgrazing and consequent degradation. Good land management, including control of total grazing pressure can avoid overgrazing (Handley 1996).

Pastoralism (stock)

The Australian Natural Resources Audit identified grazing pressure as the primary threat to Lake Ballard (Cowan 2001). Cattle access may have a number of detrimental impacts on Lake Ballard. Grazing removes native ground cover, providing a niche for weed establishment and allowing soil erosion to occur. Heavy grazing pressure will also kill larger plants, particularly when combined with excessive nutrient inputs from animal waste. Germinants and regenerating plants are highly susceptible to grazing, as they tend to be more palatable to stock. The loss of a generation of young plants to grazing can prevent the system from rebounding following events such as flood or fire. Erosion is also facilitated by soil disturbance from hoofed animals. Stock exclusion fencing is an unlikely solution, given the extensive area of the lake. However, it may be feasible to fence sections of the lake, where the impacts of cattle are greatest. The area where the IAI RCM survey was conducted did not show impacts from grazing, although some cow dung was observed.

Mining

Impacts associated with mining or mineral exploration could affect the ecology of Lake Ballard (Lynch 1995). Historically, a number of exploration activities have been undertaken on and around the lake without causing significant disturbance (Handley 1996). However, the level of threat posed by mining appears to have escalated. It has been reported that a lease has been

granted over a prospective nickel deposit in 2008[1]. There is also potential for expansion of mining activities in the lake catchment, which would have associated impacts on hydrology

Tourism

Lake Ballard receives significant tourist visitation and this has some impact on the western end of the lake. In that area there are car parks and camping areas and access to the lake floor. Foot traffic on the lake creates defined paths between areas of interest, but these are unlikely to be of much detriment to the system's integrity. Vehicular traffic on the lake floor is of more concern and there is some evidence this occurs.

Erosion

The lack of slope means that most of this system is not susceptible to soil erosion, though wind erosion of lake margins may be exacerbated by loss of stabilising perennial shrubs (Handley 1996). However, an area of sand dunes is highly susceptible to erosion. These dunes (located to the south of the sampling site) were recorded as highly eroded during the IAI RCM survey.

Climate Change

Temperature has been rising by about 0.1 ˚C per decade since 1910. This trend is expected to continue in WA. Annual rainfall is also expected in increase in inland Australia, including the Goldfields region. A trend of increasing extreme rainfall events has also been observed in all areas of the state other than the South West (EPA 2007). The hydrology of Lake Ballard is heavily reliant of cyclonic events to provide surface water. It is possible that an increase in heavy rainfall events could result in more frequent and longer periods of inundation. A higher inflow of water may be partially offset by an increase in evaporation associated with higher temperatures. It is unclear how these changes may affect the ecology of the lake, and this should be closely monitored.

[1]http://www.abnnewswire.net/press/en/58069/Nickelore_Limited_(ASX:NIO)_Report_Significant_Events_During_The_Quarter

Table 7 – Threat assessment for Lake Ballard.

An estimate is provided of the perceived likelihood of goal failure resulting from the impacts of each identified threat category.

Goal: to maintain the geomorphology and hydrology of Lake Ballard, thus ensuring it remains a suitable breeding site and migratory stopover for waterbirds and retains its cultural and scientific values.

Threat category	Management issue	Probability (%) that threat will cause goal failure with:		Assumptions underlying initial probability assessment and explanatory notes
		Existing management	Extra management	
Altered biogeochemical processes	Hydrological processes, particularly salinity	0	0	There is no evidence of alteration to the hydrology of Lake Ballard.
	Carbon cycle and climate change	5	5	Temperature and annual rainfall are both expected to increase. Extreme rainfall events are also expected to be more frequent. This may result in longer and more frequent inundation of Lake Ballard. The impacts of climate change are unclear and difficult to predict.
Impacts of introduced plants and animals	Environmental weeds	0	0	Weeds do not appear to be affecting Lake Ballard.
	Herbivory, wallowing and trampling by introduced species	10	10	The western end of Lake Ballard, where the IAI RCM survey was conducted, did not appear to be affected by herbivory or trampling. However, other areas of the lake are known to be degraded. The lake's peripheral chenopod vegetation is highly preferred for grazing by introduced and native animals, rendering it susceptible to overgrazing and consequent degradation. Fencing the entire lake margin is unlikely to be feasible, so management of these impacts is problematic.
	Predation	15	5	Predation by introduced cats and foxes poses a significant risk to breeding colonies of waterbirds, particularly Banded Stilt.
Impacts of problem native species	Overgrazing by native species	0	0	Grazing by native taxa does not appear to be problematic.
Impacts of disease	Plant pathogens	0	0	No impacts are evident.
Detrimental regimes of physical disturbance events	Fire regimes	0	0	Fire is unlikely to significantly affect the predominately chenopod vegetation surrounding Lake Ballard.
	Drought	0	0	Climate change projections for inland Australia show an increase in rainfall. Therefore, drought is unlikely to affect Lake Ballard.
	Flood	5	5	Alteration to rainfall and hydrological fluxes associated with global climate change may impact on the ecology of Lake Ballard. The nature of the impacts is not clear and should be monitored.

Threat category	Management issue	Probability (%) that threat will cause goal failure with:		Assumptions underlying initial probability assessment and explanatory notes
		Existing management	Extra management	
Impacts of pollution	Herbicide, pesticide or fertiliser use and direct impacts	0	0	Pastoralism usually does not make use of such chemical and, at present, no intensive agriculture or broadscale cropping is practiced in the area.
Impacts of competing land uses	Recreation management	1	0	Lake Ballard receives significant tourist visitation, but this is largely confined to walkways and is unlikely to have significant deleterious impacts.
	Nutrient enrichment of water body	2	2	It is likely that cattle accessing the lake will result in nutrient enrichment of the water body. However, the mainly dry nature of the lake, combined with its extensive area, appears to prevent the development of eutrophic conditions.
	Urban and industrial development	0	0	The low population density of the region makes it unlikely that any development in the area would be pursued.
	Consumptive uses	0	0	It is unlikely consumptive use of Lake Ballard by local Aboriginal people is continuing.
	Illegal activities	1	0	No evidence of any threat. However, high tourist visitation and the mainly dry nature of the lake make it susceptible to illegal 4x4 driving on the lakebed.
	Mines and quarries	10	10	The lake bed includes prospective mineral tenements and exploitation is likely.
Insufficient ecological resources to maintain viable populations	Habitat, genetic exchange	1	1	Lake Ballard is well connected to extensive areas of natural, or near-natural, environment. Populations are likely to self-supporting in this setting. Off-site impacts on migratory birds could potentially reduce their population size to unsustainable levels, but this could not be addressed at a site level.

6. Knowledge Gaps and Recommendations for Future Monitoring

Lake Ballard was dry at the time of the 2008 IAI RCM survey. As a result, data gaps from this survey include aquatic invertebrates, water quality, waterbirds and aquatic vegetation. Previous surveys have recorded the waterbird composition of the lake, as well as descriptions of vegetation. However, Lake Ballard has not previously been sampled for aquatic invertebrates or water quality. As such, these are significant knowledge gaps that can be rectified with additional surveys when the lake is inundated.

On a bioregional scale, identified knowledge gaps include vegetation and regional ecosystem mapping, a systematic fauna survey, floristic data, and ecological and fauna life history data. There are also no quantitative data on the effect of exotic predators, weed colonisation, fire, mineral extraction and water extraction (Cowan 2001).

Uncertainties exits regarding the potential effect of climate change on Lake Ballard's ecology. Detailed hydrological studies would be of benefit to inform management of the lake.

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Appendix 1 – Vegetation Condition

Table 8 – Overall Vegetation Community Condition Rating as adapted from Thackway and Lesslie (2005). Shading indicates the condition of Lake Ballard.

Overall Community Condition Rating					
	0	1	2	3	4
	RESIDUAL BARE	**NATURAL**	**IMPACTED**	**DEGRADED**	**REMOVED/REPLACED**
Community Condition Class	Areas where native vegetation does not naturally persist	Native vegetation community structure, composition and regenerative capacity intact - no significant perturbation from land management practices	Native vegetation community structure, composition and regenerative capacity intact but perturbed by land management practices	Native vegetation community structure, composition and regenerative capacity significantly altered by land management practices	Species present are alien to the locality and either spontaneous in occurrence or cultivated. Alternatively, vegetation may have been removed entirely
Regenerative Capacity	Natural regenerative capacity unmodified - ephemerals and lower plants	Regenerative capacity intact. All species expected to show regeneration are doing so	Natural regenerative capacity somewhat reduced, but endures under current/past land management practices	Natural regenerative capacity limited and at risk due to land management practices. Rehabilitation and restoration possible through removal of threats	Regenerative potential of native vegetation has been suppressed by ongoing disturbances. There is little potential for restoration
Vegetation Structure	Nil or minimal	Structural integrity of native vegetation is very high. All expected strata, growth forms and age classes are present	Structure is altered but persists, i.e. some elements of a stratum are missing	Structure of native vegetation is significantly altered, i.e. one or more strata are missing entirely	All structural elements of native vegetation are missing or highly degraded
Vegetation Composition	Nil or minimal	Compositional integrity of native vegetation is very high. All species expected at the site are present	Composition of native vegetation is altered. All major species are present, although proportions may have changed. Some minor species may be missing	Significant species are missing from the site and may have been replaced by opportunistic species. Loss of species affects structure of vegetation	Native vegetation removed entirely +/- replaced with introduced species

Appendix 2 – Herbarium Plant Records

Plant specimens submitted to the Western Australian Herbarium:
Tecticornia laevigata (RCM016-R1-04)

Table 9 – Herbarium Records for Lake Ballard.

Search Coordinates: NW corner 29°13'26"S, 120°31'0 8"E; SE corner 29°42'55"S, 121°16'57"E

Family	Genus	Species	Rank	Infraspecies	Alien	Cons. Status
Aizoaceae	*Tetragonia*	*eremaea*				
Amaranthaceae	*Ptilotus*	*aervoides*				
		chamaecladus				
		exaltatus	var.	*exaltatus*		
				villosus		
		gaudichaudii	var.	*gaudichaudii*		
		helipteroides	var.	*helipteroides*		
		holosericeus				
		obovatus	var.	*obovatus*		
		polystachyus	var.	*polystachyus*		
Anacardiaceae	*Schinus*	*molle*			Y	
			var.	*areira*	Y	
Anthericaceae	*Dichopogon*	*tyleri*				
	Thysanotus	*manglesianus*				
Apiaceae	*Daucus*	*glochidiatus*				
	Trachymene	*cyanopetala*				
		ornata				
Asclepiadaceae	*Marsdenia*	*australis*				
	Rhyncharrhena	*linearis*				
Asphodelaceae	*Bulbine*	*semibarbata*				
Asteraceae	*Actinobole*	*uliginosum*				
	Asteridea	*athrixioides*				
		chaetopoda				
	Brachyscome	*ciliaris*				
		ciliocarpa				
		sp.				
	Calotis	*multicaulis*				
	Centaurea	*melitensis*			Y	
	Cephalipterum	*drummondii*				
	Erodiophyllum	*acanthocephalum*				
	Helipterum	*craspedioides*				
	Hyalosperma	*zacchaeus*				
	Lawrencella	*davenportii*				
	Lemooria	*burkittii*				
	Leucochrysum	*fitzgibbonii*				
	Millotia	*incurva*				
	Minuria	*cunninghamii*				
	Myriocephalus	*guerinae*				
	Olearia	*muelleri*				
		pimeleoides				
		subspicata				
	Podolepis	*canescens*				
	Pogonolepis	*stricta*				
	Rhodanthe	*charsleyae*				
		chlorocephala	subsp.	*rosea*		
				splendida		
		floribunda				

Family	Genus	Species	Rank	Infraspecies	Alien	Cons. Status
Asteraceae	*Rhodanthe*	*haigii*				
		humboldtiana				
		maryonii				
		pygmaea				
		stricta				
	Schoenia	*cassiniana*				
	Senecio	*glossanthus*				
	Streptoglossa	*liatroides*				
		sp.				
	Trichanthodium	*skirrophorum*				
	Verbesina	sp.				
	Waitzia	*acuminata*	var.	*acuminata*		
Brassicaceae	*Arabidella*	*trisecta*				
	Lepidium	*didymum*			Y	
		oxytrichum				
	Sisymbrium	*orientale*			Y	
	Stenopetalum	*filifolium*				
		sphaerocarpum				
Cactaceae	*Cylindropuntia*	*rosea*			Y	
Caesalpiniaceae	*Senna*	*artemisioides*				
			subsp.	*filifolia*		
				x artemisioides		
		cardiosperma				
		pleurocarpa				
			var.	*angustifolia*		
		sp. Meekatharra (E. Bailey 1-26)				
Casuarinaceae	*Allocasuarina*	sp.				
Chenopodiaceae	*Atriplex*	*codonocarpa*				
		nummularia	subsp.	*spathulata*		
		quadrivalvata	var.	*quadrivalvata*		
		semilunaris				
		sp.				
		vesicaria				
	Dissocarpus	*paradoxus*				
	Dysphania	*glomulifera*	subsp.	*eremaea*		
	Enchylaena	*tomentosa*				
	Eriochiton	*sclerolaenoides*				
	Halosarcia	*halocnemoides*				
		pergranulata	subsp.	*pergranulata*		
	Maireana	*amoena*				
		appressa				
		carnosa				
		eriosphaera				
		georgei				
		planifolia				
		platycarpa				
		pyramidata				
		thesioides				
		tomentosa	subsp.	*tomentosa*		
		trichoptera				
	Osteocarpum	*salsuginosum*				
	Rhagodia	*drummondii*				
		preissii	subsp.	*preissii*		
	Salsola	*tragus*				
	Sclerolaena	*cuneata*				
		densiflora				

Family	Genus	Species	Rank	Infraspecies	Alien	Cons. Status
Chenopodiaceae	*Sclerolaena*	*eurotioides*				
		fimbriolata				
		gardneri				
		patenticuspis				
	Tecticornia	*peltata*				
Colchicaceae	*Wurmbea*	*tenella*				
Convolvulaceae	*Convolvulus*	*remotus*				
Cupressaceae	*Callitris*	*canescens*				
		columellaris				
		preissii				
Cuscutaceae	*Cuscuta*	*planiflora*			Y	
Droseraceae	*Drosera*	*macrantha*	subsp.	*macrantha*		
Euphorbiaceae	*Bertya*	*dimerostigma*				
	Euphorbia	*drummondii*				
Frankeniaceae	*Frankenia*	sp.				
Geraniaceae	*Erodium*	*cygnorum*				
Goodeniaceae	*Brunonia*	*australis*				
		sp. Goldfields (K.R. Newbey 6044)				
	Dampiera	*roycei*				
	Goodenia	*gypsicola*				
		havilandii				
		macroplectra				
		maideniana				
		mimuloides				
		peacockiana				
		pinnatifida				
		sp.				
	Scaevola	*collaris*				
		spinescens				
	Velleia	*daviesii*				
		hispida				
		rosea				
Gyrostemonaceae	*Codonocarpus*	*cotinifolius*				
Haloragaceae	*Gonocarpus*	*confertifolius*	var.	*helmsii*		
	Haloragis	*odontocarpa*				
			forma	*rugosa*		
		trigonocarpa				
Lamiaceae	*Hemiphora*	*elderi*				
	Lachnostachys	*coolgardiensis*				
			forma	*brevispicata*		
		verbascifolia	var.	*verbascifolia*		
	Newcastelia	*insignis*				P2
		viscida				
	Physopsis	*viscida*				
	Prostanthera	*albiflora*				
		althoferi	subsp.	*althoferi*		
Loranthaceae	*Amyema*	*benthamii*				
		fitzgeraldii				
Malvaceae	*Abutilon*	*oxycarpum*	subsp.	*prostratum*		
	Radyera	*farragei*				
	Sida	*calyxhymenia*				
		ectogama				
Mimosaceae	*Acacia*	*aneura*				
			var.	*aneura*		
				aneura/intermedia		
Mimosaceae	*Acacia*	*aneura*		*argentea*		

Family	Genus	Species	Rank	Infraspecies	Alien	Cons. Status
		ayersiana				
		burkittii				
		colletioides				
		coolgardiensis	subsp.	*effusa*		
				effusa (Pedunculate variant)		
		craspedocarpa				
		helmsiana				
		heteroneura	var.	*prolixa*		
		jennerae				
		ligulata				
		murrayana				
		oswaldii				
		quadrimarginea				
		ramulosa	var.	*ramulosa*		
		resinimarginea				
		rhodophloia				
		sibirica				
		tetragonophylla				
Myoporaceae	*Eremophila*	*alternifolia*				
		caperata				
		clarkei				
		decipiens	subsp.	*decipiens*		
		eriocalyx				
		falcata				
		forrestii	subsp.	*forrestii*		
		glabra	subsp.	*tomentosa*		
				verrucosa		
		glandulifera				
		granitica				
		ionantha				
		maculata	subsp.	*brevifolia*		
		metallicorum				
		miniata				
		mirabilis				P2
		oldfieldii	subsp.	*angustifolia*		
		oppositifolia	subsp.	*angustifolia*		
		pantonii				
		platycalyx	subsp.	*platycalyx*		
		platythamnos	subsp.	*platythamnos*		
		scoparia				
		serrulata				
		sp.				
		youngii	subsp.	*youngii*		
Myrtaceae	*Aluta*	*aspera*				
	Baeckea	sp. Comet Vale (A.S. George 8078)				
	Calytrix	*desolata*				
		warburtonensis				P2
	Darwinia	*halophila*				
	Eucalyptus	*carnei*				
		celastroides	subsp.	*celastroides*		
		clelandii x striaticalyx				
		comitae-vallis				
		concinna				
Myrtaceae	*Eucalyptus*	*horistes*				

Family	Genus	Species	Rank	Infraspecies	Alien	Cons. Status
		jutsonii				P2
		leptopoda	subsp.	*arctata*		
				subluta		
		lesouefii				
		longissima				
		loxophleba	subsp.	*lissophloia*		
		lucasii				
		moderata				
		oldfieldii				
		oleosa				
			subsp.	*oleosa*		
		rigidula				
		salmonophloia				
		trichopoda				
		yilgarnensis				
		youngiana				
	Euryomyrtus	*maidenii*				
	Leptospermum	*fastigiatum*				
	Malleostemon	*roseus*				
	Micromyrtus	*flaviflora*				
		serrulata				P3
	Thryptomene	*eremaea*				P2
		urceolaris				
Papilionaceae	*Glycine*	*canescens*				
	Medicago	*truncatula*			Y	
	Swainsona	*affinis*				
		canescens				
		formosa				
		halophila				
		rostellata				
		tenuis				
Pittosporaceae	*Bursaria*	*occidentalis*				
		sp.				
	Marianthus	*bicolor*				
Plumbaginaceae	*Limonium*	*lobatum*			Y	
Poaceae	*Aristida*	*contorta*				
	Austrodanthonia	*caespitosa*				
	Austrostipa	*platychaeta*				
	Bromus	*arenarius*				
		japonicus	var.	*vestitus*	Y	
		rubens			Y	
	Digitaria	*brownii*				
	Eragrostis	*dielsii*				
		eriopoda				
		lanipes				
	Rostraria	*pumila*			Y	
	Triodia	*scariosa*				
Polygonaceae	*Acetosa*	*vesicaria*			Y	
	Muehlenbeckia	*florulenta*				
Primulaceae	*Anagallis*	*arvensis*			Y	
Proteaceae	*Banksia*	*elderiana*				
	Grevillea	*erectiloba*				P4
		sarissa	subsp.	*sarissa*		
		subterlineata				P3
	Hakea	*lorea*	subsp.	*lorea*		
Rhamnaceae	*Cryptandra*	*connata*				
Rutaceae	*Phebalium*	*canaliculatum x laevigatum*				

Family	Genus	Species	Rank	Infraspecies	Alien	Cons. Status
		laevigatum				
	Philotheca	*brucei*	subsp.	*brucei*		
		coateana				P3
Santalaceae	*Santalum*	*acuminatum*				
Sapindaceae	*Dodonaea*	*amblyophylla*				
		lobulata				
		rigida				
		viscosa	subsp.	*angustissima*		
Solanaceae	*Duboisia*	*hopwoodii*				
	Nicotiana	*occidentalis*	subsp.	*obliqua*		
	Solanum	*lasiophyllum*				
		nummularium				
Stylidiaceae	*Stylidium*	*longibracteatum*				
Thymelaeaceae	*Pimelea*	*angustifolia*				
		microcephala	subsp.	*microcephala*		
		trichostachya				
Zygophyllaceae	*Zygophyllum*	*fruticulosum*				
		iodocarpum				
		ovatum				
		simile				
		tetrapterum				