


Parks and reserves of the south-west Kimberley and north-west Pilbara

Draft joint management plan 2016

GOVERNMENT OF WESTERN AUSTRALIA

Conservation and Parks Commission

Department of Parks and Wildlife

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This draft plan was prepared by the Conservation and Parks Commission, the Karajarri Traditional Lands Association, the Nyangumarta Warrarn Aboriginal Corporation, and the Wanparta Aboriginal Corporation through the agency of the Department of Parks and Wildlife.

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Cover photographs:

Top left: Dragon trees over bulrush at Dragon Tree Soak, Kurriji Pa Yajula Nature Reserve. Photo – Stephen Reynolds/Environs Kimberley
Top right: Saunders Spring, Walyarta Conservation Park. Photo – Jan van de Kam
Bottom right: Kujungurru-Warrarn Nature Reserve looking south from Waru Creek. Photo – Parks and Wildlife
Bottom left: Salt Creek, Walyarta Conservation Park. Photo – Jan van de Kam
Main: Greater bilby. Photo – Bert and Babs Wells/Parks and Wildlife

This document is available in alternative formats on request.

Invitation to comment

This draft joint management plan has been released for a three-month period to provide the public with an opportunity to comment on how the reserves covered by the plan are proposed to be managed over the next ten years.

To ensure your submission is as effective as possible:
- be clear and concise
- refer your points to the page numbers or specific sections in the plan
- say whether you agree or disagree with any or all of the management arrangements – clearly state your reasons, particularly if you disagree
- give sources of information where possible
- suggest alternatives for those aspects of the plan with which you disagree.

The draft plan will be reviewed in the light of the submissions, according to the criteria outlined below. A summary of public submissions will be made available along with the final management plan.

The draft plan may be amended if a submission:
- provides additional information of direct relevance to management
- indicates a change in (or clarifies) government legislation or management policy
- proposes strategies that would better achieve management objectives
- indicates omissions, inaccuracies or a lack of clarity.

The draft plan may not be amended if a submission:
- clearly supports proposals in the plan or makes general or neutral statements
- refers to issues beyond the scope of the plan
- refers to issues that are already noted within the plan or already considered during its preparation
- is one among several widely divergent viewpoints received on the topic but the approach in the plan is still considered the best option
- contributes options that are not feasible (generally due to conflict with legislation or government policy)
- is based on unclear or factually incorrect information.

The draft plan can be viewed and submissions made online at:
www.dpaw.wa.gov.au/parks/management-plans/draft-plans-open-for-public-comment.

Alternatively, you can write to:
Planning Branch
Department of Parks and Wildlife
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Summary

This draft joint management plan provides direction for the joint management of existing and proposed parks and reserves in the south-west Kimberley and north-west Pilbara regions; a coastal strip of conservation estate comprising nature reserves and conservation parks (Eighty Mile Beach coastal reserves), Walyarta Conservation Park and Kurriji Pa Yajula Nature Reserve.

The *Kimberley Science and Conservation Strategy* is a commitment by the State to recognise and conserve significant natural and cultural values of the region and to provide increased opportunities for Aboriginal involvement in land and sea management. A key objective of the strategy is to establish a representative system of jointly managed protected areas (Government of Western Australia 2011).

The creation of new parks and reserves in the south-west Kimberley and north-west Pilbara and the subsequent preparation and implementation of this plan contributes to the delivery of the strategy, and are key features of Indigenous Land Use Agreements (ILUAs) negotiated with the Karajarri, Nyangumarta and Ngarla people. Each traditional owner group has a special connection with, and responsibility for, the lands and waters within their native title determination areas.

The plan describes the cultural heritage, natural, recreation, tourism, community and resource use values of the planning area and analyses management issues. It identifies objectives, strategies and key performance indicators, to provide a robust framework to protect and manage the area's values and support adaptive management.

The purpose of the plan is to ensure:

- the planning area is managed in an ecologically sustainable and a culturally appropriate manner
- management of relevant parts of the planning area is consistent with and complements management of the Eighty Mile Beach Marine Park
- management of relevant parts of the planning area is consistent with Australia's obligations under the Ramsar Convention.

Management needs to ensure that access to culturally sensitive and significant areas is appropriate. Access restrictions to a number of cultural sites will be given effect through the implementation of the plan. Traditional owners can continue to enjoy and maintain their customary activities in the planning area. Joint management of new and existing reserves will also result in better integration of traditional knowledge with contemporary science and land practices.

Maintaining the integrity of hydrological systems that provide critical ecosystem services, and maintaining the condition and extent of wetland habitats, are high priorities for management, along with the conservation of threatened species and communities.

Over the next 10 years, visitation is likely to remain focused on existing nodes along the coast and just outside of the planning area, such as Eighty Mile Beach Caravan Park and Cape Keraudren. These provide access to the adjacent Eighty Mile Beach Marine Park and offer the best options for managing visitor risk and safety. New cultural ecotourism opportunities may also be investigated.

The key management issues are introduced herbivores (including domestic stock) and inappropriate fire regimes. Walyarta Conservation Park and the Eighty Mile Beach coastal reserves have a long history of pastoralism. Destocking and fencing are important strategies to allow these areas to recover from grazing and to prevent adverse impacts on sensitive sites. Other land uses in the vicinity of the planning area have the potential to affect the hydrology and functioning of significant wetlands. These issues occur at a landscape-scale and, when considered with the fragmented nature of the planning area, it is essential to adopt a cooperative, integrated management approach involving all neighbouring land managers.

Developing an understanding of the key values of the planning area and collecting the relevant baseline data will be a strong focus in the early stages of implementation. It is a priority to increase understanding of the water requirements and regimes that are needed to sustain the groundwater dependent ecosystems of the planning area. It is essential to establish a long-term monitoring program to evaluate management effectiveness and inform adaptive management.

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1. Introduction

1.1 The reserves and their values

The existing and proposed parks and reserves of the south-west Kimberley and north-west Pilbara regions (the planning area) include the lands and waters of the Karajarri, Nyangumarta and Ngarla people, who have continuing rights and responsibilities for these areas. The region's geomorphology and hydrology gives rise to a spectacular and complex array of landscape features and habitats, from the coastal dunes along Eighty Mile Beach, to freshwater mound springs and inland mangroves that emerge along an ancient river channel, to the striking red sand dunes and sandplains of the Great Sandy Desert.

The planning area comprises the Eighty Mile Beach coastal reserves (Jinmarnkur Conservation Park, Jinmarnkur Kulja Nature Reserve, Kujungurru-Warrarn Nature Reserve, Kujungurru-Warrarn Conservation Park, unnamed 'Gap' nature reserve, Jarrkunpungu Nature Reserve, and a proposed unnamed nature reserve), Walyarta Conservation Park and Kurriji Pa Yajula Nature Reserve.

The key values of the planning area are grouped under four headings.

Cultural heritage – the reserves are living cultural landscapes which include sacred sites, stories and songlines that cross the broader region, linking places and people. Many sites are believed to be created and inhabited by *pulany* (powerful mythical water snakes) and must be respected and approached in the right way. These sites and the associated knowledge and traditions, demonstrate the long and ongoing connection traditional owners have with this area.

Natural – the planning area encompasses a range of wetland types and part of the internationally significant Eighty Mile Beach Ramsar site. The reserves support large numbers of wildlife, as well as populations of threatened species, and provide breeding habitat for waterbirds, particularly when flooded. Mound springs and permanent water sources maintain unique vegetation associations and have important refugia value for biodiversity. The planning area contains several threatened and priority ecological communities.

Walyarta Conservation Park. Photo – Chris Nutt/Parks and Wildlife

Recreation, tourism and community – Eighty Mile Beach Marine Park is adjacent to the planning area, and accessible locations along the coast will be the focus for visitation. They provide opportunities for nature-based tourism and recreation for travellers between the Pilbara and the Kimberley. Traditional owners have expressed interest in developing new cultural ecotourism ventures.

Resource use – the existing and potential activities associated with the planning area are pastoralism, abstraction of groundwater and resource exploration and development.

Names of the reserves

The Karajarri, Nyangumarta and Ngarla people have chosen the names of the reserves of the planning area. The origin and meaning of the names are listed below.

Table 1 Reserve names, origins and meanings

Reserve name	Origin and meaning
Kurriji Pa Yajula	A *pukarrikarra* (Dreaming) site for Karajarri people. Contains two *jila* (permanent water sources), namely *Kurriji* and *Yajula*.
Walyarta	Nyangumarta place name associated with the salt and freshwater marshlands that stretch from the desert to the coast. *Walyarta* is a common name for the area used by both the Nyangumarta and the Karajarri people.
Jinmarnkur	Karajarri place name for the area known as Cape Missiessy, the northern point of Eighty Mile Beach. Karajarri people visited *Jinmarnkur* to use a fish trap called *kunjunku* and often caught *pirala* (whiskered salmon).
Jinmarnkur Kulja	*Jinmarnkur* (jin-marn-goor) is the traditional Karajarri place name for the area known as Cape Missiessy. *Kulja* means 'south' in Karajarri language.
Kujungurru Warrarn	Nyangumarta place name meaning 'country around the ocean or sea around the country'.
Jarrkunpungu	Ngarla place name for Solitary Island. The origin for *Jarrkunpungu* is a Dreaming story: *Marnmulkura*, an Ancestral Being (an octopus) attempted to steal a firestick from the people. When *Marnmulkura* was descending into the ocean, *Winti-Winti* the nankeen kestrel intercepted him and snatched the firestick from him. *Marnmulkura* instantly turned to stone, becoming Solitary Island (J. Brown Snr *pers. comm.* 2016).

1.2 Management context

Joint management partners

The lands and waters of the planning area are highly significant to the culture and heritage of the Karajarri, Nyangumarta and Ngarla people, who are the determined native title holders over the planning area. The Nyangumarta and Karajarri people also have a shared native title determination within the planning area, and the State Government has recently negotiated an Indigenous Land Use Agreement (ILUA) with the Nyangumarta–Karajarri Aboriginal Corporation (NKAC) for this particular determination area.

Karajarri cultural advisors Rene Hopiga and Celia Bennett. Photo – Tom de Souza

Joint management will provide the opportunity for the Department of Parks and Wildlife (Parks and Wildlife) to work in partnership with the area's traditional owners, to achieve the objectives set out in this plan. Each traditional owner group has joint management responsibility for the reserves (or parts of the reserves) located within their native title determination areas (see Table 2).

The CEO of Parks and Wildlife will jointly manage the relevant parts of the planning area with the Karajarri Traditional Lands Association (KTLA), the Nyangumarta Warrarn Aboriginal Corporation (NWAC) and the Wanparta Aboriginal Corporation (WAC) people in accordance with Joint Management Agreements (JMAs) pursuant to section 56A of the *Conservation and Land Management Act 1984* (CALM Act). Joint management will formally commence upon execution of the JMAs (to be attached to the final joint management plan and signed as soon as practicable following its approval).

Planning and decision making

The JMAs will establish Joint Management Bodies (JMBs) to oversee management of the planning area in accordance with the agreements and the CALM Act. The JMBs will make management decisions, provide strategic input into how management strategies are implemented, and strategically monitor the implementation of the plan.

Administration

Under the guidance of the JMBs, the West Kimberley District of Parks and Wildlife will be responsible for coordinating the operational management of the planning area. The regional office in Kununurra and a number of other specialist branches will provide support, direction and assistance. It may be beneficial for all joint management partners to come together on an annual basis to share experiences, celebrate achievements and participate in operational planning.

Ngarla and Nyangumarta rangers Augustine Badal, Jeffrey Brown, Nathan Hunter and Stephen Brown. Traditional owner rangers will play an important role in implementing this plan. Photo – Miecha Bradshaw/Parks and Wildlife

Legislative and policy framework

A variety of Acts, Regulations, policies and agreements apply to, or have relevance to, this plan and the planning area. The Karajarri, Nyangumarta and Ngarla people hold native title rights and interests over the planning area. These rights and interests are recognised by the common law of Australia and protected through the *Native Title Act 1993* (Cth). This is discussed further in the section **Connection to country**.

The planning area will be managed in accordance with the CALM Act, which provides for the protection of native flora and fauna and Aboriginal culture and heritage on lands and waters vested in the Conservation and Parks Commission, and the *Wildlife Conservation Act 1950* (Wildlife Conservation Act), which provides specific protection for native flora and fauna within the State.

The Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) relates to the protection of nationally listed species and ecological communities, heritage (including Ramsar wetlands) and migratory species protected under international agreements. The EPBC Act also establishes a framework for managing Ramsar sites, in the form of the Australian Ramsar management principles.

Numerous Parks and Wildlife policies are also relevant to this plan.

International conservation agreements

The Convention on Wetlands (known as the Ramsar Convention) is an international treaty concerned with the conservation and wise use of wetlands. Walyarta Conservation Park and the Eighty Mile Beach coastal reserves protect portions of the Eighty Mile Beach Ramsar site[1], which was listed as a wetland of international importance in June 1990 (see **Appendix I**). Under the Convention, Contracting Parties accept a number of responsibilities, including a commitment to prevent changes to the ecological character of listed wetlands. The *Ecological Character Description of the Eighty Mile Beach Ramsar Site* (Hale and Butcher 2009) is an important guiding document for the planning area.

In addition to the Ramsar Convention, Australia is a signatory to bilateral agreements with China (China–Australia Migratory Bird Agreement), Japan (Japan–Australia Migratory Bird Agreement) and the Republic of Korea (Republic of Korea–Australia Migratory Bird Agreement) to provide a collaborative framework for the protection of habitats of migratory birds within the East Asian–Australasian Flyway. A number of species listed in these agreements occur in the planning area and some are also listed under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

1.3 Planning area

Location

The planning area (Map 1) is located in north-western Australia approximately 1700km from Perth and falls within both the Shire of East Pilbara and Shire of Broome.

Covering an area of 7,061ha, the Eighty Mile Beach coastal reserves (Map 2) run parallel to the Eighty Mile Beach Marine Park stretching almost 220km from Cape Missiessy in the north to Cootenbrand Creek in the south. Under the classification scheme provided in the Interim Biogeographic Regionalisation of Australia (IBRA7), the Eighty Mile Beach coastal reserves are located within the Dampierland (Pindanland subregion) bioregion.

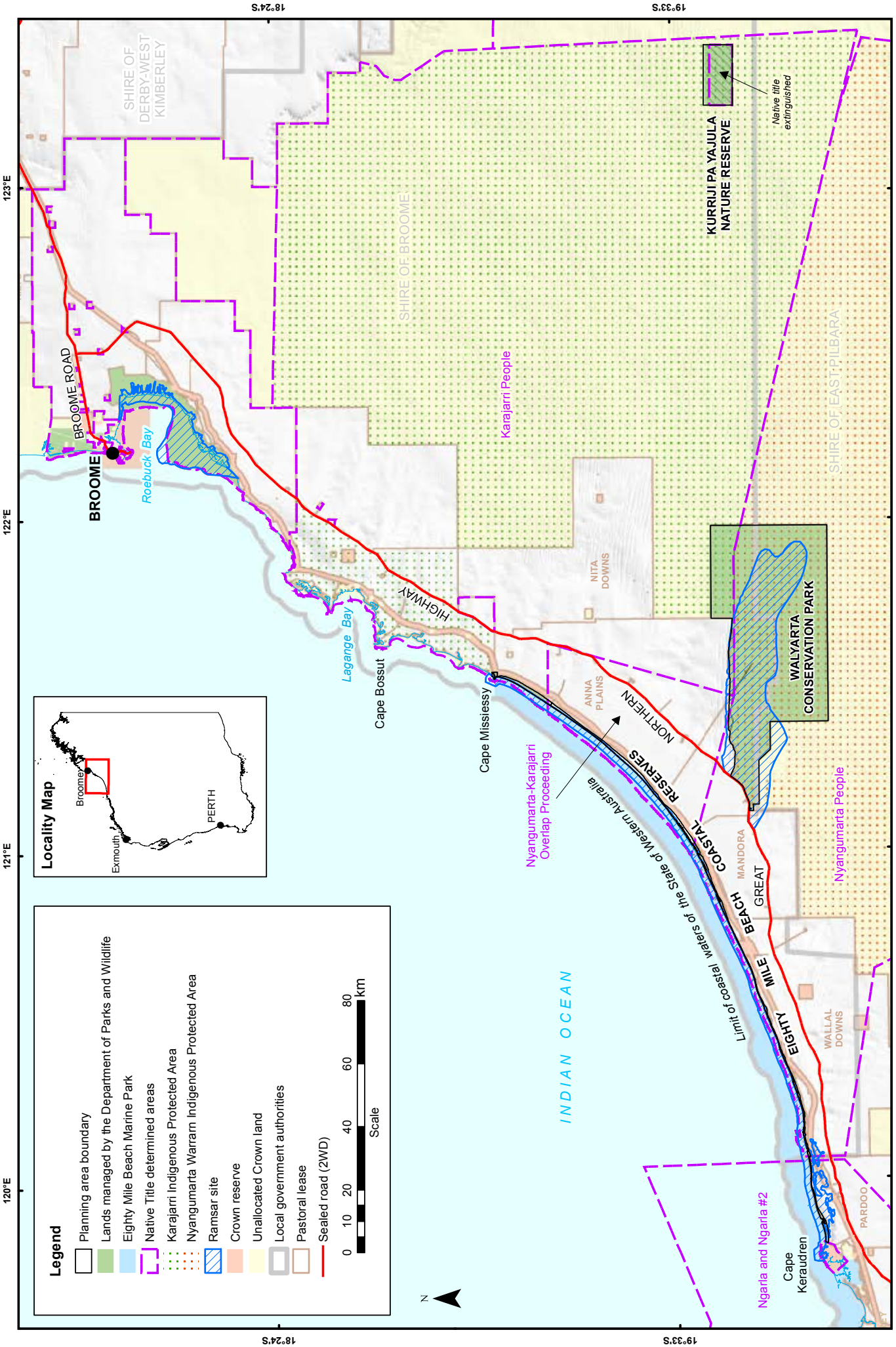
Walyarta Conservation Park (Map 3) is on the western edge of the Great Sandy Desert and covers an area of 231,358ha. It extends east-west for approximately 95km. It is located at the junction of the Dampierland (Pindanland subregion) and Great Sandy Desert (McLarty subregion) bioregions, however, the latter contains the main body of the reserve.

Kurriji Pa Yajula Nature Reserve (Map 4) is located a further 140km to the east-north-east, covering an area of 17,729ha. It is situated completely within the Great Sandy Desert bioregion (McLarty subregion).

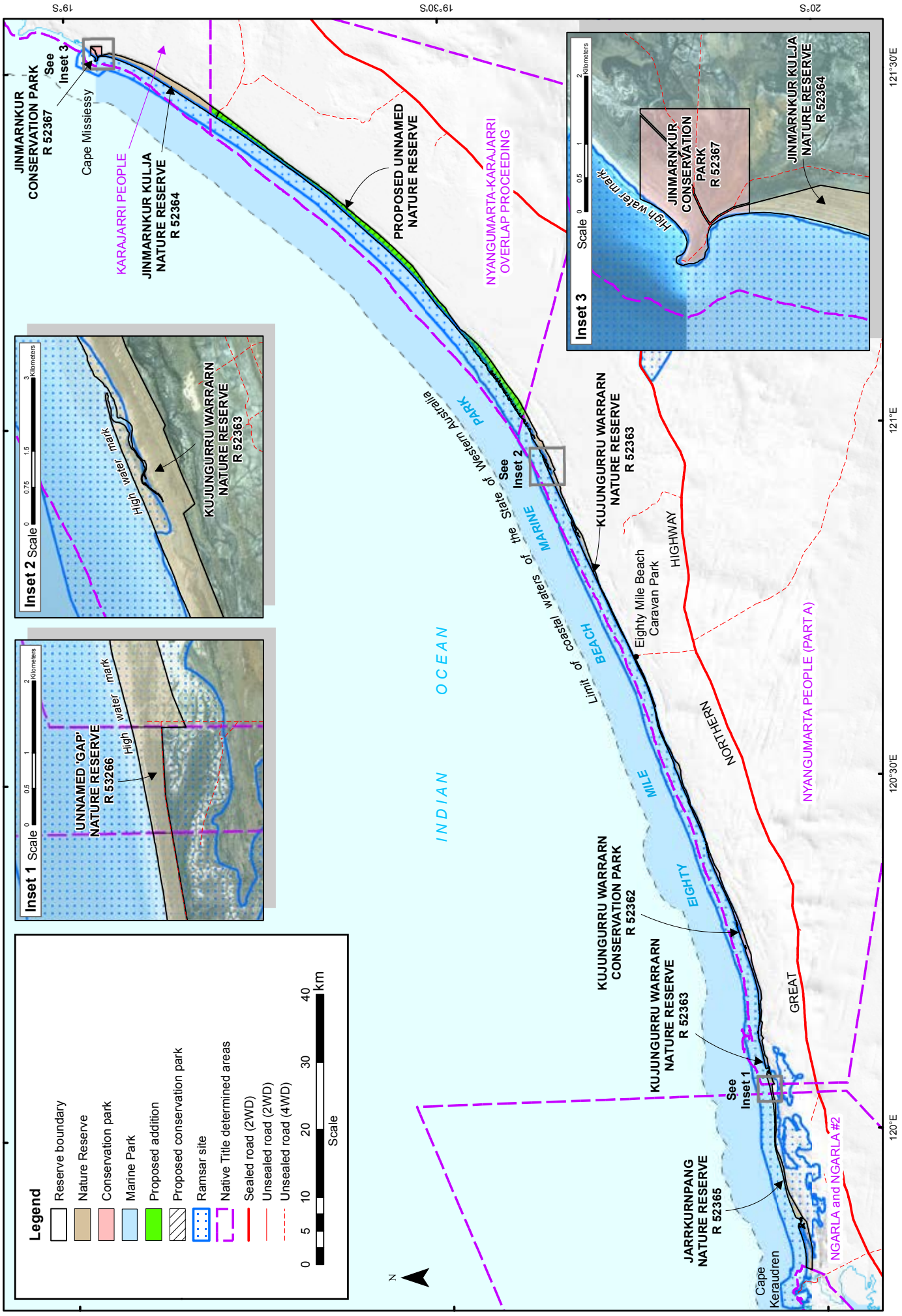
Eighty Mile Beach coastal reserves and adjacent marine park. Photo – Parks and Wildlife

[1] The rest of the Ramsar site is largely covered by Eighty Mile Beach Marine Park and managed in accordance with the CALM Act, with smaller areas also occurring on unallocated Crown land and pastoral lease on surrounding lands.

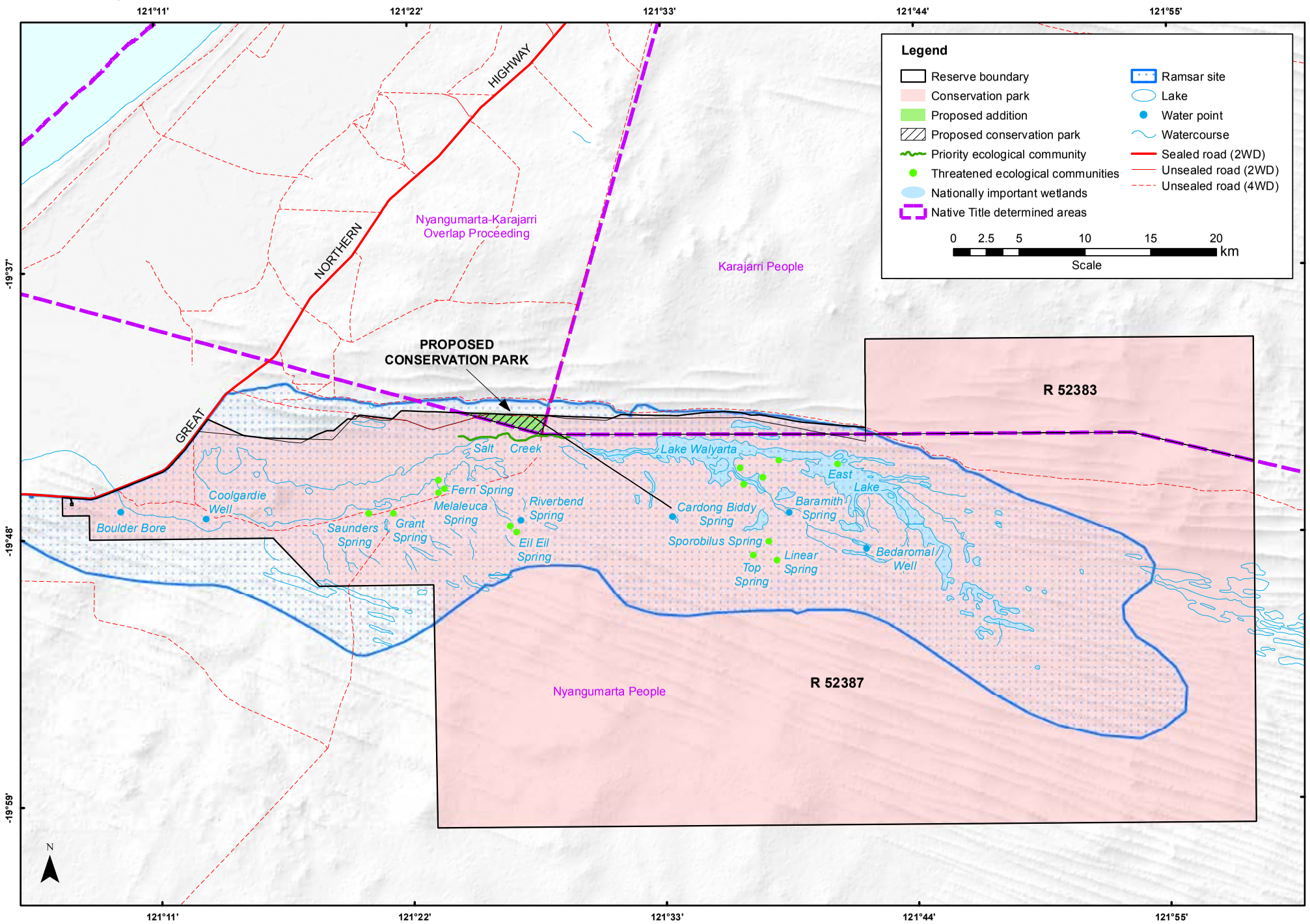
Map 1 Overview of the planning area



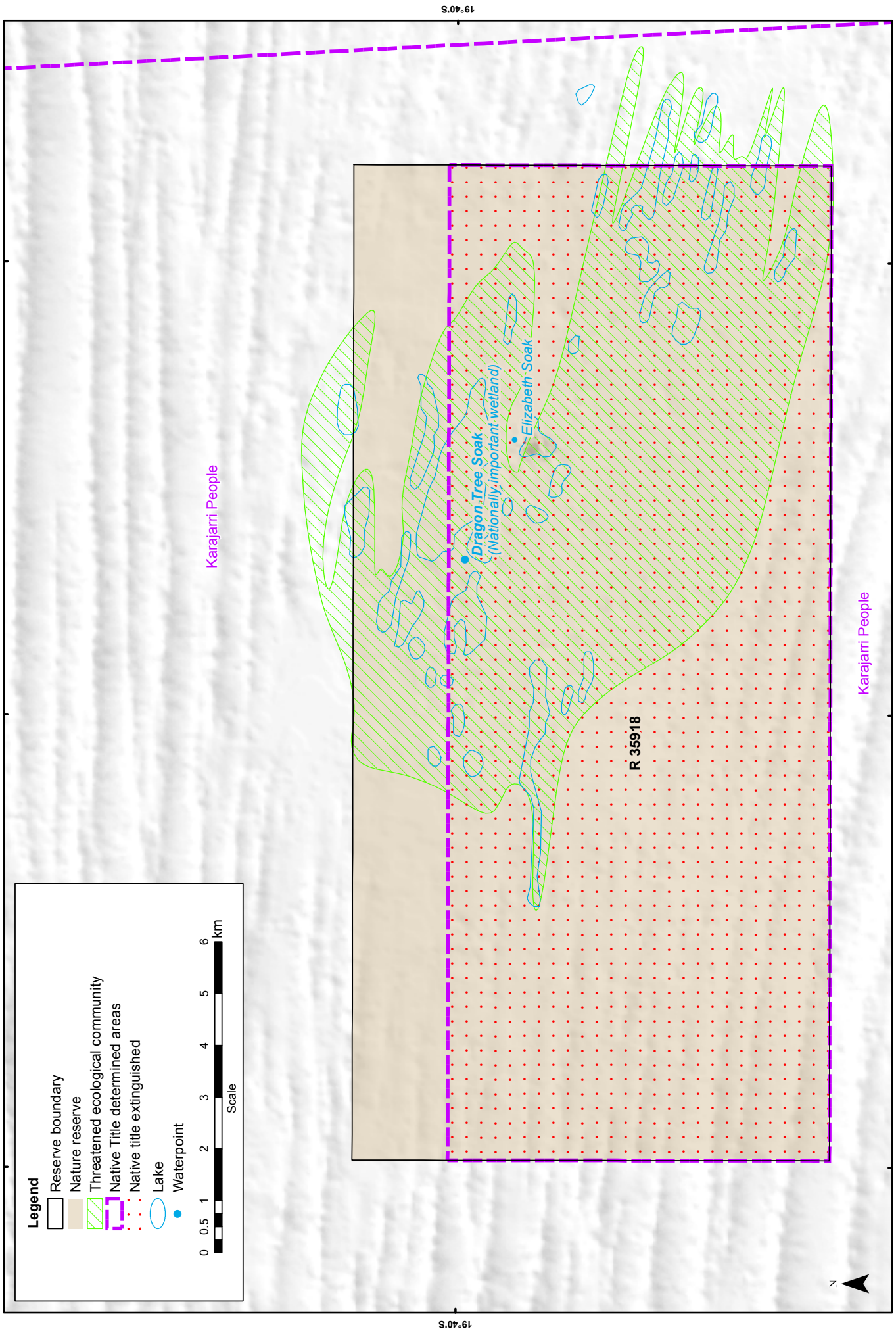
Map 2 Eighty Mile Beach coastal reserves



Map 3 Walyarta Conservation Park



Map 4 Kurriji Pa Yajula Nature Reserve



Tenure and proposed land arrangements

Kurriji Pa Yajula (formerly Dragon Tree Soak) Nature Reserve was first gazetted in March 1979 with an area of 14,182ha. An additional 3,547ha were added to the reserve in December 1994.

Walyarta Conservation Park and the Eighty Mile Beach coastal reserves listed in Table 2 are new additions to the conservation reserve system, gazetted on 1 September 2016. Large portions of these reserves were held under pastoral lease until 30 June 2015, after which they were excised as a result of long standing arrangements with the respective pastoral lessees.

Table 2 Existing tenure of the planning area

Reserve name	Tenure	Class	Reserve number	Area (ha)	Traditional owners	Vested
Kurriji Pa Yajula	Nature reserve	A	35918	17,729	Karajarri	Jointly with Conservation and Parks Commission and KTLA
Walyarta	Conservation park	Unclassified	52383	24,731	Karajarri	Jointly with Conservation and Parks Commission and KTLA
			52387	206,627	Nyangumarta	Jointly with Conservation and Parks Commission and NWAC
Eighty Mile Beach coastal reserves (from north to south)						
Jinmarnkur	Conservation park	Unclassified	52367	268	Karajarri	Jointly with Conservation and Parks Commission and KTLA
Jinmarnkur Kulja	Nature reserve*	A	52364	1,727		
Kujungurru Warrarn	Nature reserve*	A	52363	2,555	Nyangumarta	Jointly with Conservation and Parks Commission and NWAC
Kujungurru Warrarn	Conservation park	Unclassified	52362	1,139		
Unnamed 'Gap'	Nature reserve*	A	52366	44	Undetermined	Conservation and Parks Commission
Jarrkunpungu	Nature reserve*	A	52365	1,372	Ngarla	Jointly with Conservation and Parks Commission and WAC

* To a depth limit of 200m.

Once the ILUA for the shared Nyangumarta–Karajarri determination area is registered, the proposed portion of Walyarta Conservation Park and the proposed unnamed nature reserve can be formally created (Table 3).

Table 3 Tenure of proposed additions to the planning area

Reserve name	Tenure	Class	Traditional owners	Vested
Walyarta	Conservation park	Unclassified	Nyangumarta–Karajarri	Jointly with Conservation and Parks Commission and NKAC
Unnamed	Nature reserve*	A	Nyangumarta–Karajarri	Jointly with Conservation and Parks Commission and NKAC

* Proposed to a depth limit of 200m.

Native title rights exist over all tenure in the planning area except the southern portion of Kurriji Pa Yajula Nature Reserve where native title has been determined to be extinguished. The unnamed 'Gap' nature reserve is located between the Nyangumarta and Ngarla determination areas and is subject to native title applications from both of these traditional owner groups. It is solely vested with the Conservation and Parks Commission until the native title applications above are resolved.

Adjacent lands and off-reserve management

Key values and management issues occur, and are influenced by land use activities, beyond the boundary of the planning area. The high perimeter to area ratio of the Eighty Mile Beach coastal reserves make them particularly vulnerable. The planning area is bordered by pastoral leases, unallocated Crown land and Eighty Mile Beach Marine Park (see Map 1). A road reserve, the De Grey Stock Route and some smaller reserves of varying purpose also occur in the vicinity. Some mining tenements and petroleum exploration permits exist along the Eighty Mile Beach coastal reserves (see **Using resources from country**), and Eighty Mile Beach Caravan Park, Reserve 39135 at Cape Keraudren (Cape Keraudren Coastal Reserve) and Pardoo Station are important recreational nodes with caravan and camping facilities available (see **People on country**).

Effective management cannot be achieved in isolation, but must be integrated with management across the broader landscape. Parks and Wildlife and its joint management partners will need to work collaboratively with adjacent land managers (e.g. shires of Broome and East Pilbara, pastoralists[2] and caravan park owners) to maintain an appropriate level of access and ensure cross-boundary issues such as weeds, feral animals, fire and water abstraction are considered and addressed. These management issues are further discussed in the relevant sections of this plan. Lessons from other regional works programs (e.g. North Kimberley Landscape Conservation Initiative) may also be applicable.

Several government agencies have responsibility for, and provide advice on, landscape-scale management issues such as declared pest animals and plants (Department of Agriculture and Food), water resource use (Department of Water) and fire management (Department of Fire and Emergency Services). A close working relationship must also be maintained with the Commonwealth Department of the Environment with regard to management of key values relevant to the EPBC Act, including the Eighty Mile Beach Ramsar site.

Where other lands are identified as having conservation significance, as supporting the listing criteria for the Ramsar Convention, or as having the potential to strengthen ecological connectivity (e.g. coastal plains adjacent to Eighty Mile Beach), they may be considered for addition to the conservation reserve system or the Ramsar site.

Other protected areas

Several other protected areas are relevant to the management of the planning area.

Eighty Mile Beach Marine Park abuts the Eighty Mile Beach coastal reserves. It was gazetted in January 2013 and covers an area of approximately 200,000ha, including all of the State waters within the Eighty Mile Beach meso-scale bioregion and a small portion of the Pilbara Nearshore meso-scale bioregion. The marine park is a Class A reserve jointly managed with the Karajarri, Nyangumarta and Ngarla traditional owners. *Eighty Mile Beach Marine Park Management Plan No. 80 2014-2024* outlines the values and management arrangements for the marine park (Parks and Wildlife 2014).

In 2014, the Karajarri people declared an Indigenous Protected Area (IPA) across 24,797km^2 (more than 2.4 million ha) of Karajarri country. It includes Kurriji Pa Yajula Nature Reserve and the Karajarri portion of Walyarta Conservation Park. The *pirra* (inland desert area) of the IPA is an IUCN Category VI protected area, with the primary objectives of nature conservation and sustainable resource use. The Karajarri traditional owners would like to increase the area of their IPA to include sea country adjacent to and north of the planning area. *Karajarri Healthy Country Plan 2013-2023* sets out the long-term conservation targets and management strategies (KTLA 2014).

The Nyangumarta traditional owners declared the Nyangumarta Warran IPA in 2015 across 28,675km^2 (more than 2.8 million ha) of their country. The IPA is listed as IUCN Category VI and includes the Nyangumarta portion of Walyarta Conservation Park, Kujungurru Warrarn Nature Reserve, Kujungurru Warrarn Conservation Park and Eighty Mile Beach Marine Park (Nyangumarta Part). *Nyangumarta Warrarn Indigenous Protected Area Plan of Management 2015-2020* provides strategic direction for management of the IPA (NWAC and YMAC 2015).

While the various reserves across the landscape have been planned and established independently of each other, the result is a mosaic of protected areas extending from the Great Sandy Desert to the coastal waters of Eighty Mile Beach.

[2] For example, over many years the lessee of Anna Plains pastoral station worked with Parks and Wildlife and its predecessors to manage a coastal strip

Karajarri elders Philip Wildridge and Joe Edgar at *Jinmarnkur* (Cape Missiessy). Lands north-east of this point are part of Frazier Downs pastoral lease and managed as the Karajarri IPA while coastal waters to the west are part of Eighty Mile Beach Marine Park. Photo – Matt Fossey/Parks and Wildlife

1.4 Term of the plan

The final joint management plan will guide management of the planning area for 10 years. If the plan is not reviewed and replaced by the end of the 10-year period, it will remain in force until a new plan is approved. Amendments to the plan may be made in accordance with the CALM Act and the ILUAs relevant to the planning area.

Summary of management directions for joint management, legislative and policy framework, tenure arrangements and adjacent lands

Key points and considerations
• The planning area and proposed additions comprise a number of nature reserves and conservation parks collectively referred to as the Eighty Mile Beach coastal reserves; the Walyarta Conservation Park; and the Kurriji Pa Yajula Nature Reserve. • The CEO of Parks and Wildlife will jointly manage the relevant parts of the planning area with the Karajarri, Nyangumarta and Ngarla traditional owners and will formalise this arrangement under the CALM Act through section 56A JMAs. • The State has recently negotiated an ILUA with the Nyangumarta–Karajarri native title holders for the shared native title determination area. • The JMAs will establish JMBs to oversee management of the planning area in accordance with the agreements and the CALM Act. • Operational management will be coordinated by the West Kimberley District of Parks and Wildlife. • Large portions of the planning area were held under pastoral lease until 30 June 2015. • A landscape-scale management approach is needed for the planning area, involving adjacent land managers, other agencies and the wider community. The Eighty Mile Beach coastal reserves in particular have a very high perimeter to area ratio which makes management challenging and will require a coordinated approach from neighbouring land managers. • A variety of Acts, Regulations, policies, agreements (e.g. Ramsar Convention, migratory bird agreements, ILUAs and JMAs) and management documents apply to, or have relevance to, this plan and the planning area.

Management objectives	Strategies
1. Formally protect all parts of the planning area through reservation within two years of the release of this plan. 2. Maintain close working relationships and regular and open communication with traditional owners. 3. Promote effective coordinated cross-boundary management of landscape-scale influences. 4. Ensure legislative requirements and other commitments are met during plan implementation.	Continue to progress reservation of the proposed additions as outlined in Table 3.
	Conduct at least two meetings a year with each JMB.
	Provide opportunities for training and mentoring traditional owner rangers and continue to provide equitable support to the Karajarri Ranger group on a fee-for-service basis.
	Develop and implement a monitoring and evaluation framework to assess joint management effectiveness of the planning area (i.e. how joint management arrangements work for Parks and Wildlife and traditional owners and whether the arrangements themselves are functioning effectively).
	Facilitate the transfer of information from research and monitoring to the joint management partners (e.g. through research licence or other approval conditions).
	Liaise with, and provide advice and support to, relevant agencies, stakeholders and neighbouring landholders with management and monitoring responsibilities (e.g. Department of Agriculture and Food, Department of Water, Shire of Broome and pastoralists) across the planning area and on surrounding lands, including portions of the Eighty Mile Beach Ramsar site that occur outside the formal conservation reserve system.
	Ensure that research and monitoring in the planning area is integrated with that being undertaken in adjacent protected areas.
	Adhere to and/or maintain consistency with relevant legislative and other key documents as outlined above.

2. Vision and strategic goals

2.1 Vision

"The living cultural landscapes, significant wetlands, and unique plant and animal communities of the planning area are protected and looked after for future generations, jointly with the Karajarri, Nyangumarta and Ngarla traditional owners and with neighbouring land managers and the wider community."

Karajarri traditional owners at Elizabeth Soak, Kurriji Pa Yajula Nature Reserve. Photo – Ilse Pickerd/Environs Kimberley

2.2 Strategic goals

A set of strategic goals has been developed for the planning area that provides a link between the vision statement and the desired outcomes expressed through the objectives identified in this plan. The strategic goals are to:

- uphold and respect the culture and traditional knowledge of the Karajarri, Nyangumarta and Ngarla traditional owners
- protect and conserve the value of the land to the culture and heritage of Aboriginal people
- provide for sustainable traditional and customary Aboriginal use and enjoyment
- conserve and restore wetlands of international and national significance
- conserve biodiversity and maintain ecosystem processes and function
- increase understanding of the cultural heritage, natural values, and management issues to support adaptive management
- provide for recreation, tourism and resource use that is compatible with and respectful to the area's cultural heritage and natural values.

Spinifex sandplain and melaleuca thicket, Walyarta Conservation Park. Photo – Jan van de Kam

3. Connection to country (cultural heritage values)

Protecting and conserving the value of the land to the culture and heritage of Aboriginal people is a priority for all joint management partners of the planning area, as well as an objective under section 56(2) of the CALM Act.

3.1 Dreamtime and traditional law

The traditional owners of the planning area believe the landscape, its features and all forms of life were created by supernatural Ancestral Beings during the Dreamtime (*Pukarrikarra* or *Pukarrikarrajangka*). These Ancestral Beings also created the social and cultural norms and different regional languages and inscribed the country with meaning (KTLA 2014; NWAC and YMAC 2015).

Traditional law is a set of rules that guides the area's traditional owners in all aspects of their life. The physical environment, plants and animals have been inseparable from traditional law, culture, language and knowledge since Creation Time and this is integral to the maintenance and protection of country. Under traditional law, the Karajarri, Nyangumarta and Ngarla people have a binding responsibility to care for country and keep culture strong. Country is the source of spirit, culture and language and is where spirits return when they die.

3.2 Traditional knowledge

Traditional owners, especially the elders, collectively hold an extensive body of cultural and ecological knowledge that has been developed over millennia. In accordance with traditional law, they are responsible and obliged to transfer knowledge to the younger generation. This is typically undertaken while spending time on country camping, telling stories, performing song and dance, participating in ceremonies and rituals, making spears, fishing, hunting, learning about bush tucker and natural medicine, and generally through everyday life (KTLA 2014; NWAC and YMAC 2015). Traditional ecological knowledge is underpinned by seasonal calendars and the life cycles of individual species, as well as a deep spiritual attachment to country (Willing 2014).

Karajarri traditional owners, Kurriji Pa Yajula Nature Reserve. Being on country is the best place for old people to pass on traditional knowledge to the younger generation. Photo – Ilse Pickerd/Environs Kimberley

Traditional owners are increasingly concerned about the difficulties in being able to pass on their traditional knowledge because of limited opportunities to spend time on country due to distance, costs, access and health conditions; the younger generation being distracted by modern influences and becoming less interested in learning about their own culture and heritage; and elders passing away before all their knowledge can be passed on (NWAC and YMAC 2015). The Karajarri people are particularly keen to use modern technology to document, and make available as appropriate, traditional knowledge, including language, to ensure the longevity of their culture and heritage (KTLA 2014).

Management of this value will focus on gaining a better understanding of traditional knowledge applicable to the planning area, and investigating opportunities for integration with contemporary conservation science and management. Previous collaborative research projects in the planning area have benefited both scientists and traditional owner groups (e.g. Yu 2000 and Semeniuk Research Group 2000). Successful integration requires an understanding and appreciation that traditional knowledge is part of a complementary worldview with its associated values, institutions and management systems.

3.3 Plants, animals and sites of significance

Plants and animals have sustained Aboriginal people living on country for many years, providing them with food, water and medicine. Elkin (1933) noted that many plants and animals are totems for the Karajarri people; special ceremonies are performed, "expressing desire for the spirits of totemic species to go forth and increase". In addition, knowing when plants and animals are in season is an important part of maintaining good health and provides guidance for safe travel overland for long periods of time (KTLA 2014). Establishing sustainable harvest strategies for favoured animals, bush foods and medicines on country is necessary to ensure that these resources maintain a healthy condition and persist into the future in good numbers (KTLA 2014). Appropriate fire regimes ('right-way fire') are also a key factor in their successful conservation. The emu (*Dromaius novaehollandiae*) and the Australian bustard or bush turkey (*Ardeotis australis*) are two species that are culturally important to the area's traditional owners but, based on anecdotal evidence, may be in decline locally.

Nyangumarta elder with bush turkey. This is a culturally important species that may benefit from sustainable harvest strategies and targets. Photo – Chris Nutt/Parks and Wildlife

The pathways of Ancestral Beings traverse the planning area and their tangible form is present in sacred sites. As outlined above, traditional owners are responsible for and obliged to protect, preserve and manage sites and objects of significance associated with their country. Seven Aboriginal sites within the planning area are recorded on the Department of Aboriginal Affairs' Register of Aboriginal Sites, although this probably only represents a small proportion of the actual sites that occur there. These include water sources as well as ceremonial, mythological, and men's and women's sites. Kurriji Pa Yajula was also noted by Yu (2000) as an important place for Karajarri people to exchange trading parcels and objects with the nearby Martu people and establish friendships and alliances, which sometimes led to marriages.

More generally, permanent and seasonal/temporary water sources, especially the wetlands of the planning area, hold great cultural and spiritual significance. Water plays a key role in cultural practices and stories, as well as being used by traditional owners for survival as they traversed country following the seasonal availability of resources and in modern times when just spending time on country (KTLA 2014; Yu 2000). Many of these sites also have spiritual value, having been created and inhabited by *pulany*, snake beings or serpents with the powers to produce rain, regenerate or damage country and take people's lives (Yu 2000). Acknowledging and respecting the origin, type and hydrological integrity of these water sources ensures the health of the *ngurrara* (country) and all forms of life, as well as visitor safety, is maintained.

Box 1: *Pulany*

Both the Karajarri and Nyangumarta people regard *pulany* as powerful beings who are to be respected and approached in prescribed ways. They believe that *pulany* can exhibit human emotions, such as anger, which can be manifested as violent storms, with lightning and wild winds, and cyclones.

The presence of *pulany* at springs is often indicated by *panyjin* reeds, which grow in the springs and are said to be the whiskers of the *pulany*. It is considered dangerous, particularly for children, to swim near areas where the *panyjin* grow. Because of the unpredictability of the *pulany*, traditional owners never camp in the immediate vicinity of permanent water sources.

(Yu 2000; Nyangumarta People *pers. comm.* 2012)

There is a strong connection to the adjacent coastal pastoral stations, associated with long-term employment dating back to the 1920s, birth place, ceremonial areas and burial sites, the latter of which are highly vulnerable to disturbance (NWAC and YMAC 2015). Most burial sites are unfenced and traditional owners would like to fence them to stop damage by cattle. A considerable proportion of the planning area was previously part of these pastoral leases and may contain some of these significant sites (e.g. burial sites located in coastal dunes).

Nyangumarta traditional owners, Walyarta Conservation Park. Photo – Matt Fossey/Parks and Wildlife

All Aboriginal sites, registered or otherwise, are protected under the *Aboriginal Heritage Act 1972*. Depending on the cultural sensitivity, these sites can be vulnerable to a variety of management issues (e.g. weeds, introduced animals, inappropriate visitation and development) that are discussed in more detail in the relevant sections of this plan. In many cases, maintaining confidentiality and restricting access to people who have special cultural authority in culturally sensitive areas will be imperative to retaining site integrity. Provisions for special access restrictions have been incorporated into this plan accordingly.

3.4 Enjoyment of country and customary practices

Although the majority of the traditional owners of the planning area live in towns and communities such as Port Hedland, Broome and Bidyadanga, families and individuals retain close personal connections (social, spiritual and cultural) with their country. For example, a number of *yirrau* (anecdotal songs composed and sung for pleasure) illustrate the connection the Ngarla people have with their coastal territory (Brown and Geytenbeek 2003).

There is a strong desire to continue living on country from time to time, learning about and enjoying important places and utilising the resources of the land. Therefore, the ability to access parts of the planning area for customary practices is crucial. Provisions of the CALM Act enable traditional owners to access country for customary purposes, such as preparing and consuming food, preparing or using medicine, and engaging in artistic, ceremonial or other customary activities. This will assist traditional owners of the planning area to continue these traditions, transfer knowledge to younger generations and protect and conserve these values. Further information is available in the *Guide to Aboriginal customary activities on Parks and Wildlife-managed lands and waters* (Parks and Wildlife 2014a).

As much of the planning area is difficult to access, providing an appropriate level of vehicle access to sites where traditional owners can continue to undertake cultural activities and responsibilities is the main requirement for the management of this value. In particular the Karajarri people have expressed the need for improved access to Kurriji Pa Yajula Nature Reserve, as it takes several days by vehicle to reach the reserve from the Great Northern Highway (Reynolds *et al.* 2015).

Karajarri traditional owners fishing at Salt Creek, Walyarta Conservation Park. Photo – Matt Fossey/Parks and Wildlife

Summary of management directions for cultural heritage values

Key points and considerations
• Under traditional law, traditional owners have a binding responsibility to care for country and keep their culture strong. • Being on country is the best place for traditional owners to engage with their culture and for elders to pass on knowledge of country to younger generations. • Establishing some sustainable harvest strategies will ensure that favoured food animals and bush foods are available in healthy numbers. • Water sources, especially the wetlands of the planning area, hold great cultural and spiritual significance to traditional owners. Many sites are believed to be created and inhabited by *pulany* (mythical water snakes) and must be respected and approached in the right way. • Local pastoral stations feature strongly in the memories of many traditional owners and are an important part of their heritage and contemporary identity. • Access to certain culturally sensitive areas may be restricted to people who have special cultural authority. • Traditional owners can continue to enjoy and maintain their customary practices in the planning area. • Traditional owners are concerned about difficulties in accessing parts of the planning area and thus carrying out customary activities and passing on knowledge of country.

Management objectives	Strategies
1. Recognise, protect and conserve the planning area as being part of living cultural landscapes. 2. Support retention of traditional knowledge and its integration into management operations, research projects and monitoring. 3. Support traditional owners to carry out their roles and responsibilities as protectors and managers of their country and culture. 4. Recognise and support the rights of traditional owners to continue customary practices in the planning area. 5. Monitor changes of the key cultural heritage values of the planning area, to provide a basis to assess, adapt and improve management.	Implement strategies in this plan to maintain or improve the health of country.
	Develop a shared understanding and appreciation of the cultural significance of the planning area to traditional owner groups (e.g. through cultural heritage mapping on country or other means as appropriate).
	Support the collation and recording of traditional knowledge from senior traditional owners and other sources, and encourage its uptake for management of the planning area.
	Develop and observe JMB-approved processes and protocols for undertaking management activities and/or integrating traditional knowledge with contemporary science and management (e.g. 'right-way fire' to protect important sites and species and promote habitat diversity).
	Support on-country trips by younger and older generations of traditional owners to the planning area to maintain permanent water sources and keep *pulany* alive, ensure knowledge, stories and songs about country are passed on, and to undertake other customary activities.
	Liaise with traditional owners to determine which sites of high cultural sensitivity may require special access restrictions and implement as appropriate.
	Ensure cultural and heritage places are protected and maintained, in particular highly significant and sensitive sites at immediate risk (e.g. fencing of burial sites).
	In partnership with each traditional owner group, identify culturally important species (e.g. availability and abundance of bush medicines, fruits and favoured food animals) and develop and apply sustainable harvest strategies and management targets.
	Assess factors that may inhibit the rights of traditional owners to enjoy country and maintain their customary practices, and explore/implement management interventions to address issues as necessary.
	Ensure that traditional owners have a primary and active role in communication about their culture and heritage.
	Monitor the condition of culturally significant sites and species in the planning area to determine whether these are being adequately protected and maintained.

KEY PERFORMANCE INDICATORS (KPIs)		
Performance measures	**Targets**	**Reporting requirements**
Level of traditional owner satisfaction that traditional knowledge is being consulted and adopted into management.	Traditional owners are satisfied that traditional knowledge is being consulted and adopted as appropriate into management of the planning area.	Annually.
Condition of significant cultural and heritage places.	• All sites and areas with cultural and gender access restrictions are communicated and observed. • No new signs of physical disturbance to specified sites and areas within three years of the release of the plan.	Annually.
Condition of culturally important species.	To be developed by/with each traditional owner group.	Annually.
Level of traditional owner satisfaction that they have been able to continue customary practices and remain custodians of country and culture.	Traditional owners are satisfied that they are able to access the planning area for the purposes of carrying out customary practices, transferring knowledge to younger generations and enjoying country.	Annually.

4. Caring for country (natural values)

The planning area has significant ecological and cultural (see **Connection to country**) values. This plan focuses on management of species and communities, however a more general description of the natural environment of the planning area has been included in **Appendix II**.

4.1 Wetlands of significance

The planning area contains wetland landscape features recognised nationally and internationally for their geomorphic and hydrological values. These in turn support unique plant and animal communities, and sustain a range of ecosystem services (Department of Environment, Water, Heritage and the Arts 2009).

The wetlands of the planning area are largely a result of geomorphology and hydrological interactions (for more information, refer to **Appendix II**). The entire area is part of a large palaeodrainage system called the Wallal Paleoriver, with the wetlands of Walyarta Conservation Park and the coastal plains previously being a shallow marine system, and probably part of an estuary.

Walyarta Conservation Park principally comprises the Mandora Marsh wetland complex, which includes a number of saline and freshwater wetland types, such as intermittent saline lakes and marshes (Lake Walyarta and East Lake), permanent saline streams (Salt Creek), freshwater springs and freshwater peatlands. It is unusual for saline and freshwater wetland types to occur in close proximity to one another. Many of the wetlands in the reserve are sustained by groundwater. The raised peat bog and mound spring of Eil Eil Spring is the most developed in the region, and is considered a unique geomorphic formation wetland ecosystem (Department of the Environment 2016).

Saunders Spring with central, raised mound of peat, Walyarta Conservation Park. Photo – Jan van de Kam

Kurriji Pa Yajula Nature Reserve comprises two permanent mound springs (Dragon Tree Soak and the smaller Elizabeth Soak). The soaks and peatlands are small in size but are regarded as oases within the Great Sandy Desert. Like the springs of Mandora Marsh, they are believed to be groundwater dependent.

In addition to being part of the internationally significant Eighty Mile Beach Ramsar wetland site (see **Appendix I**), the Mandora Marsh complex is listed on the Directory of Important Wetlands in Australia as it is a good example of a wetland type occurring within a biogeographic region in Australia (criterion 1); is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions prevail (criterion 3) and is of outstanding historical or cultural significance (criterion 6) (Environment Australia 2001). Dragon Tree Soak is also recognised as being nationally important by meeting criteria 1 and 6 (Environment Australia 2001).

The wetlands of the planning area are important research sites, with the mound springs and grey mangrove (*Avicennia marina*) community of Salt Creek being of considerable scientific interest. An improved understanding of surface water and groundwater recharge and flows is essential to their conservation and management.

4.2 Flora, fauna and ecological communities

Priority flora

At the time of publication, two Priority 1 species were recorded in the planning area:

- *Atriplex eremitis*, a recently described saltbush species which occurs on tussock grassland (Cranfield 2008). Records exist from two locations, including one from inside the planning area.
- *Nicotiana heterantha*, a short-lived annual or perennial herb often associated with melaleuca thickets on black clay and seasonally wet flats.

Nine Priority 3 species have also been recorded: *Acacia glaucocaesia*, *Fimbristylis sieberiana*, *Fuirena incrassate*, *Gymnanthera cunninghamii*, *Indigofera ammobia*, *Pterocaulon xenicum*, *Solanum oligandrum*, *Terminalia kumpaja* and *Lawrencia* sp. Anna Plains (N.T. Burbidge 1433).

Threatened and other significant fauna

Limited fauna research has been conducted in the planning area and survey efforts to date have mainly focused on the Mandora Marsh wetland complex in Walyarta Conservation Park. This provides important habitat for waterbirds, particularly when inundated extensively. During large floods in 1999 and 2000, the site supported around 480,000 and 490,000 waterbirds respectively (Halse *et al.* 2005), although the area surveyed included land outside the boundaries of the reserve and the Ramsar site. Such flood events are also significant in supporting waterbird breeding, with species utilising different habitats within the complex (Hale and Butcher 2009).

Mandora Marsh supports a relatively rich aquatic invertebrate fauna, which Storey *et al.* (2011) attributed to the different types of permanent wetlands within the one location. The system likely has diverse groundwater fauna (stygofauna) communities that are locally to regionally endemic, but these have been poorly surveyed to date. A locally endemic fish species (an undescribed goby) has been recorded from Salt Creek (Hale and Butcher 2009; Storey *et al.* 2011).

White-winged black terns, Walyarta Conservation Park. When flooded, the lakes of the reserve support huge numbers of waterbirds.
Photo – Jan van de Kam

A number of fauna species occurring or possibly occurring in the planning area are specially protected under the Wildlife Conservation Act or listed under the EPBC Act (Table 4). The Eighty Mile Beach coastal reserves also provide some of these species with a significant buffer from external influences or disturbance and is a key reason for their reservation.

View of Kujungurru-Warrarn Nature Reserve looking south from Waru Creek. The Eighty Mile Beach coastal reserves buffer the values of the adjacent marine park. Photo – Parks and Wildlife

Table 4 Fauna of conservation significance in the planning area

Species	Wildlife Conservation Act	EPBC Act	IUCN Red List
Flatback turtle (*Natator depressus*)	Vulnerable	Vulnerable, Marine, Migratory	Data deficient
Greater bilby (*Macrotis lagotis*)	Vulnerable	Vulnerable	Vulnerable
Australian painted snipe (*Rostratula benghalensis* subsp. *australis*)	Endangered	Endangered, Marine	Endangered
Bar-tailed godwit (*Limosa lapponica* subsp. *menzbieri*)	Vulnerable, Migratory	Marine, Migratory	Least concern
Curlew sandpiper (*Calidris ferruginea*)	Vulnerable, Migratory	Critically Endangered, Marine, Migratory	Least concern
Greater sand plover (*Charadrius leschenaultii* subsp. *leschenaultii*)	Vulnerable, Migratory	Marine, Migratory	Least concern
Grey falcon (*Falco hypoleucos*)	Vulnerable	Not listed	Vulnerable

Flatback turtles are endemic to northern Australia and nest in the Eighty Mile Beach coastal reserves, with peak nesting from November to December and peak hatching from January to March. Research indicates that the flatback population at Eighty Mile Beach may be different genetically to populations further west in the Pilbara and north along the Kimberley coast (Pittard 2010). Existing and potential management issues in the coastal reserves include habitat degradation, disturbance from human interaction and activities, and disturbance or predation by feral animals. Turtles are recognised as a key value of the adjacent marine park and their management and monitoring is dealt with in the marine park plan.

The greater bilby has been recorded in a number of locations across the planning area and will be a focus for management and monitoring over the life of the plan. It occurs on recently burnt sandplains, interdune corridors, hummock grasslands and at the edges of salt lakes where samphires or melaleucas dominate (Pavey 2006). The species is highly mobile and can have large foraging ranges. An individual was recorded by remote camera in the north of Mandora Marsh complex on a 2015 survey and secondary signs (tracks, scats, diggings and burrows) were noted on the same survey and en route to Dragon Tree Soak as part of an expedition in 2014. Predation, habitat degradation by introduced herbivores, and unsuitable fire regimes are considered to be the major threats to the species in the planning area. A national recovery plan for the greater bilby (Pavey 2006) provides a framework to guide the conservation of this species, while a greater bilby interim conservation plan (Bradley *et al.* 2015) was prepared in 2015.

The greater bilby is a threatened species that occurs at a number of locations across the planning area. Management of introduced herbivores, feral cats and fire regimes will help its survival in the reserves. Photo – Damian Kelly Photography

In addition to the migratory birds listed in Table 4, at least 15 other migratory bird species have been recorded at Mandora Marsh, all of which are listed under Schedule 5 of the Wildlife Conservation Act and are the subject of international agreements. The presence of eight migratory species during a survey in September 2015 demonstrates that the complex continues to provide important habitat for migratory birds even when not in flood (Jackett and Graff 2015). As a key staging area within the East–Asian Australasian Flyway, many more migratory bird species visit Eighty Mile Beach each year. The shorebirds that feed on the beach (and roost in the coastal reserves at high tide) are a key value of the marine park and their management is primarily dealt with in the marine park plan and other key documents such as the *Wildlife Conservation Plan for Migratory Shorebirds* (Commonwealth of Australia 2015). Intertidal habitat loss in the Yellow Sea threatens the long term prospects of several migratory species (Piersma *et al.* 2016).

Two Priority 4 species, the kakarratul or northern marsupial mole (*Notoryctes caurinus*) and princess parrot (*Polytelis alexandrae*), have also been recorded in the planning area.

Ecological communities

Much of the planning area is mapped as hummock (spinifex) grassland with habitats and species commonly associated with arid, desert landscapes (Beard *et al.* 2013). The water regime, however, is regarded as the single biggest determinant of the ecology of the reserves. Permanent water sources have significant conservation value as refuges from the surrounding dry landscape and make an important contribution to the regional diversity of flora and fauna.

The coexistence of saline and freshwater wetlands in Walyarta Conservation Park gives rise to unusual vegetation associations, with plants able to tolerate saline conditions growing in proximity to species reliant on fresh water.

Inland mangroves of Salt Creek, Walyarta Conservation Park. Photo – Matt Fossey/Parks and Wildlife

The inland grey mangrove community of Salt Creek is unique and represents one of only two such communities in Australia. Located more than 50km from the coast, it has been suggested that this is a relict from a time when sea levels were higher and the site was part of an estuary (Willing and Handasyde 1999). The soaks of Kurriji Pa Yajula Nature Reserve also have relict populations of flora not found elsewhere in the Great Sandy Desert.

The planning area contains the following threatened ecological communities (TECs) and priority ecological communities:

- *Assemblages of the organic springs and mound springs of the Mandora Marsh area* – state-listed TEC, classified as Endangered. The ecological community is only known from 16 occurrences, covering a total area of about 52ha.
- *Assemblages of Dragon Tree Soak organic mound spring* – state-listed TEC, classified as Endangered. The community is known from only one occurrence covering approximately 7,940ha.
- *Inland mangrove (*A. marina*) community of Salt Creek* – Priority 1 (poorly known) ecological community. Known from only one occurrence covering approximately 47ha.

Dragon trees over bulrush at Dragon Tree Soak, Kurriji Pa Yajula Nature Reserve. Photo – Stephen Reynolds/Environs Kimberley

4.3 Management issues

Weeds, introduced animals and inappropriate fire regimes all directly threaten the key values of the reserves. The fragmented nature of the planning area and surrounding land uses increase the vulnerability of the reserves to these management issues, as well as climate change. Relationships between these issues are extremely complex, making them difficult to address in isolation.

Weeds

Remoteness helps to protect the planning area from weed impacts to an extent, though they have still entered and spread via pedestrian and vehicle access, introduced herbivores and pastoralism, particularly within Eighty Mile Beach coastal reserves and Walyarta Conservation Park. Traditional water resources are also at risk from weeds drawing on the water source and restricting access for traditional owners (KTLA 2014).

Introduced perennial grasses such as buffel grass (*Cenchrus ciliaris*) and birdwood grass (*Cenchrus setiger*) have been actively spread in the past through pastoralism and replaced many of the native grass species of the coastal dunes and the wetlands of Walyarta Conservation Park (see **Using resources from country**). During flora surveys in the west of Walyarta Conservation Park in 2015, a number of weed species were recorded, including kapok bush (*Aerva javanica*), speedy weed (*Flaveria trinervia*), Panama berry (*Muntingia calabura*), couch grass (*Cynodon dactylon*), whorled pigeon grass (*Setaria verticillata*) and carpet weed (*Phyla nodiflora*) (Markey 2016). Other potentially serious weeds that may occur in the planning area include indigo (*Indigofera oblongifolia*), parkinsonia (*Parkinsonia aculleata*), stinking passionflower (*Passiflora foetida*) and *Stylosanthes* species (especially *S. hamata*) (G. Keighery *pers. comm.* 2015).

For most weeds, control is expensive. Preventing their introduction and spread is a more cost effective option. Where weed species are detected in the planning area, the control of small manageable outbreaks is a priority. Buffel grass appears to be well established across parts of the planning area and may be difficult to contain and eradicate. Creation of the reserves should limit stock movements, though it is not understood how the recovery potential of the landscape is affected by the density or duration of buffel colonisation. Post-fire weed control can be a significant issue and further information is required to understand weed invasiveness after fire.

It should be noted that weeds can be beneficial for dune stabilisation and reducing erosion in the absence of native vegetation. In such instances, weeds should only be removed as part of an integrated weed management program that includes restoration of the site with native species.

Introduced animals

Feral camels (*Camelus dromedarius*) and donkeys (*Equus asinus*) occur in the planning area, causing habitat degradation through trampling, grazing and rubbing of vegetation, compaction and erosion of soil, and sedimentation and eutrophication of water sources (Done 1999). Both species threaten biodiversity and cultural heritage values, though camels are regarded as a higher priority for management. In Walyarta Conservation Park, camels mainly occur around springs in the eastern part of the site, although the extent of damage caused by them has not been confirmed. Between 2009-13, a national feral camel management project was carried out, which focused on managing the impacts of camels on nominated environmental sites including Mandora Marsh (Ninti One Limited 2013). Camel damage to Dragon Tree Soak was reported from site visits during the 1990s and from a trip in 2014 (Spurr 1996; Reynolds *et al.* 2015). The impacts from camels and donkeys would vary from year to year, based on seasonal conditions (Ninti One Limited 2013).

Heavy-duty exclusion fencing has previously been suggested as a method for managing the impacts of camels and donkeys on selected water sources. Disadvantages include the cost and difficulty of transporting fencing materials, risk of damage to the fencing and ongoing maintenance needs. Aerial culling is regarded as a more appropriate means of control in the planning area, where camels are at the edge of their distribution in the northern Great Sandy Desert and densities are still relatively low. Research and previous control efforts suggest that using a Judas animal control technique (i.e. where selected females are fitted with radio collars) can be effective in enhancing helicopter shooting programs in desert country (e.g. Spencer *et al.* 2015).

A group of feral camels in Kurriji Pa Yajula Nature Reserve. Camels threaten the natural and cultural values of the planning area.
Photo – Ilse Pickerd/Environs Kimberley

Feral cats (*Felis catus*), foxes (*Vulpes vulpes*) and wild dogs (*Canis lupus familiaris*) have been observed throughout the planning area and the wider region. They prey on native fauna and disrupt waterbird breeding (Department of Environment and Conservation 2009). Predation by cats and foxes, combined with changed fire regimes, has driven mammal declines and local extinctions in many parts of the country (Woinarski *et al.* 2015).

Parks and Wildlife has developed an operational plan for the effective control of introduced predators in the Eighty Mile Beach coastal reserves and the adjacent marine park (T. Sonneman *pers. comm.* 2014). It is proposed that introduced predators will be controlled at sufficiently low levels through regular strategic baiting with 1080, and by trapping and shooting where necessary. Eradication is not possible as reinvasion from adjacent landward areas with no control will always occur. Parks and Wildlife is also investing in landscape-scale feral cat baiting in different parts of the State and the trial of a new hybrid bait in the Kimberley. If successful, it may be applied in the planning area over the life of the plan.

Cane toads (*Rhinella marinus*) have not yet reached the planning area, but it is likely that they could spread into freshwater systems of Walyarta Conservation Park. While they have the potential to reduce populations of a wide range of native species through poisoning, predation and competition, the long-term impacts of cane toads are poorly understood (e.g. Shine 2010). Management priorities for the planning area include preparing for the arrival of cane toads and minimising the chance of new cane toad populations establishing ahead of the frontline (Parks and Wildlife 2014b).

For management issues from domestic livestock, see the section **Using resources from country**.

Feral cat captured on remote camera at an active bilby burrow, Walyarta Conservation Park. Photo – Parks and Wildlife

Fire

Fire is an important natural component of ecosystem function and is one of a number of factors that influences biodiversity and ecosystem condition. Cultural burning is a sustainable means of looking after country and cultural heritage values, while carbon abatement and sequestration projects may present future economic opportunities for traditional owners.

Traditionally, Aboriginal people moved seasonally throughout the landscape and lit small, patchy fires for hunting, regenerating food and medicinal plants or 'cleaning up country'. In recent decades these fire patterns have been replaced by large, hot and uncontrolled bushfires ('wrong-way fire') occurring in the mid-late dry season. Within the Kimberley, the increased intensity and frequency of fires have led to changes in vegetation structure and composition, soil erosion and decline in fauna populations, particularly small fauna with limited home ranges (Carwardine *et al.* 2011; Government of WA 2011).

Fire in the planning area and surrounding lands will typically spread over large areas of grassland, particularly after cyclonic rainfall events that stimulate the growth of spinifex and annual grasses(Department of Environment and Conservation 2008). Ignition is usually caused by dry lightning storms. Little has been documented about the impacts of fire in the planning area, although it is likely that large, hot fires would adversely affect key vegetation communities and habitats, species diversity, traditional food resources and other cultural heritage (KTLA 2014).

In very general terms, fire-sensitive species and ecosystems are most typically associated with the less flammable parts of the landscape that are not regularly exposed to fire, such as moister areas (e.g. central, peaty areas of permanent mound springs) and those with discontinuous vegetation. Saunders Spring in Walyarta Conservation Park has long been isolated from fire due to the non-flammable nature of the surrounding vegetation and the damp conditions that prevail (Department of Environment and Conservation 2009). The peat soils of the mound spring communities give rise to particular fire management considerations as they can be seriously damaged or destroyed by fires that smoulder for long periods.

Adding fire to the landscape by prescribed burning decreases the extent and frequency of unmanaged bushfires and can create a mosaic of reduced fuel levels as well as areas of older vegetation. This mosaic pattern represents habitat diversity at a landscape scale, with patches of unburnt vegetation providing refuges for native fauna. A variety of post-fire recovery (seral) states play a role in biodiversity conservation in desert landscapes (Haydon *et al.* 2000), with species such as the greater bilby likely to benefit from improved habitat favourability. Given the large fuel loads and limited vehicle access, aerial burning may be an appropriate approach for conducting prescribed burns in parts of the planning area (e.g. Kurriji Pa Yajula Nature Reserve).

Monitoring of post-fire survival and recruitment success is also necessary to determine if ecological communities are benefiting from prescribed burns. In collaboration with the Nyangumarta traditional owners, researchers from La Trobe University are establishing study areas in the Nyangumarta Warrarn IPA to assess the ecological effects of traditional fire regimes and identify regimes conducive to maintaining cultural beliefs, practices and values (S. Leonard *pers. comm.* 2016). Their findings will be applicable to fire management planning for the reserves.

Karajarri ranger Braedon Taylor undertaking fuel reduction burning.
Photo – Ewan Noakes

The interaction of fire with flammable weed species such as buffel grass remains a complicating factor for fire management in parts of the planning area. Fire may enhance weed invasion, which in turn can lead to more frequent or intense fires or suppress the regeneration of native species. Nonetheless, prescribed fire, when cool and patchy and applied to areas adjoining buffel infestations, may maintain native grass swards and provide some competition to limit the expansion of buffel grass (Department of Environment and Conservation 2008a). Where buffel grass is interspersed with native grasses, care should be taken with prescribed fire to minimise the potential for such fire events to facilitate the spread or intensification of buffel infestations.

For large parts of the planning area dominated by spinifex, fire planning and management is also guided by 16 management principles based on existing knowledge of fire behaviour and effects (see **Appendix III**).

Climate change

Climate change adds an overarching pressure to the planning area and the broader region. It interacts with existing stressors, leading to complex and unpredictable outcomes (Steffen *et al.* 2009). Hennessy *et al.* (2006) predicted that by 2030[3] the climate of north-western Australia will be slightly warmer, with a small decrease in annual rainfall. However, projections indicate that high natural rainfall variability will continue and may mask trends in average rainfall (Davis 2014). More frequent and severe droughts are expected, as well as increases in extreme weather events.

Potentially this could result in longer dry phases of the ephemeral wetlands of Walyarta Conservation Park, though this may be offset by the increased incidence and/or extent of flooding following cyclonic rainfall (Hale and Butcher 2009). Prolonged drought will result in depletion of shallower aquifers, which contribute to sustaining the freshwater mound springs of the planning area.

A rapid climate change vulnerability assessment for the mound springs of Mandora Marsh, based on the framework by Gitay *et al.* (2011), is provided in **Appendix IV**. Some mound spring communities primarily depend on deeper groundwater so are less vulnerable to the direct impacts of climate change, as the aquifers are not sustained by local contemporary rainfall. These groundwater systems can be considered less vulnerable to thermal and hydrological change over the life of this plan.

An increase in the frequency and intensity of cyclones will increase the vulnerability of the inland mangroves and melaleuca and dragon tree (*Sesbania formosa*) communities to wind damage, and may affect their ability to recover between disturbance events. The dunes of the Eighty Mile Beach coastal reserves are particularly vulnerable to erosion from severe weather if vegetation cover is reduced. For traditional owners, climate change may also affect seasonal patterns in resource availability, rendering some traditional knowledge inaccurate (KTLA 2014).

Management must aim to increase the resilience and resistance of species and ecosystems, and decrease their vulnerability to a changing climate. Uncertainty about appropriate responses to the effects of climate change means that protecting critical habitats in the planning area (e.g. wetlands) and managing other issues (e.g. weeds, introduced animals, fire and physical disturbance) are likely to be among the best options to conserve biodiversity in the immediate future. Such approaches are sometimes referred to as 'no-regret' or 'low-regret' strategies as they address short-term conservation challenges under current conditions, and provide large benefits under a range of future climate scenarios (Gross *et al.* 2016). Further research will be important in better understanding climate change impacts at a species and community level, and management should be adapted on the basis of these findings.

Parks and Wildlife research scientists take a sediment core from a mound spring in Walyarta Conservation Park. Under a changing climate, the responses of different springs will vary, with those more reliant on shallow aquifer discharge likely to show more rapid changes. Photo – Val English/Parks and Wildlife

[3] Relative to 1990.

Summary of management directions for natural values

Key points and considerations
• The planning area includes a number of internationally, nationally and regionally significant wetlands that support unusual and relict vegetation communities and have important refugia value. Many of these are groundwater dependent, though the hydrological regimes require further investigation. • Several fauna species of conservation interest have been recorded in the planning area, including the greater bilby, flatback turtle and others listed under international agreements. Records of large numbers of waterbirds are associated with flooding in Walyarta Conservation Park, though these events are infrequent. • The planning area contains two TECs and a Priority 1 ecological community. • The fragmented nature of the planning area and surrounding land uses increase the vulnerability of the reserves to weeds, introduced animals, 'wrong-way fire' and climate change. Management efforts must consider interactions between these issues, noting they may produce synergistic effects. • A number of weed species occur in the Eighty Mile Beach coastal reserves and Walyarta Conservation Park and buffel grass is widespread. Weeds can stabilise dunes in the absence of native vegetation and should only be removed as part of an integrated weed management program that includes restoration with native species. • Control of camels, donkeys, cats and foxes is needed across the planning area. Camels, in particular, threaten the integrity of freshwater springs and soaks. Cane toads may reach the reserves over the life of this plan. • Fire management will require implementation of strategic burning and input of traditional knowledge. The peat soils of the mound spring communities and buffel grass infestations have specific fire management considerations. • Protecting climate refugia such as the mound springs and reducing the impact of existing stressors are important climate change adaptation approaches. • Research should be a strong focus in the early years of implementation. For new additions to the planning area, collection of baseline data is needed to allow the condition of values to be monitored over and beyond the life of the plan. • Additional, specific monitoring and reporting requirements apply to Mandora Marsh and the primary coastal dunes due to their designation as a Ramsar wetland (see **Appendix I**).

Management objectives	Strategies
1. Sustain the hydrological regimes of the planning area, with a particular focus on groundwater dependent communities and species. 2. Conserve native flora, fauna and ecological communities of the planning area, with priority on the greater bilby and those associated with significant wetlands. 3. Sustain or restore ecosystem processes and function in the planning area by addressing key management issues of introduced herbivores and 'wrong-way fire' and the impacts of resource use (also see **Using resources from country**).	Develop and implement a collaborative and cost-effective research and monitoring program that: • maps the location of all groundwater-dependent wetlands in Walyarta Conservation Park • improves understanding of the hydrological regimes and ecological water requirements, in particular, the dependence of springs and lakes on episodic flooding and/or groundwater from different aquifers • characterises the stygofauna of the planning area • establishes baselines for key species and communities, including vegetation boundary and condition mapping • addresses knowledge gaps for values and threats for which performance measures have been identified, including risks and vulnerabilities associated with climate change • enables limits of acceptable change and operational limits to be set for critical components and processes of the Mandora Marsh portion of the Eighty Mile Beach Ramsar site • establishes and maintains post-fire monitoring sites • evaluates the conservation status of the inland mangrove community of Salt Creek • examines the response of terrestrial vertebrate fauna to destocking in the Walyarta Conservation Park (see **Using resources from country**) • utilises remote sensing technologies (e.g. for monitoring vegetation cover and extent of surface water) where feasible.

Management objectives	Strategies
4. Maintain or improve the ecological character of the Eighty Mile Beach Ramsar site (including Mandora Marsh in Walyarta Conservation Park and the areas protected by the Eighty Mile Beach coastal reserves). 5. Obtain an understanding of the key natural values of the planning area and the factors affecting those values through baseline research, mapping and addressing key knowledge gaps. 6. Monitor changes in the key natural values of the planning area, including critical components and processes of the Eighty Mile Beach Ramsar site, to provide a basis to assess, adapt and improve management.	Ensure that weed and feral animal management for the planning area is considered and incorporated into a regional management program that: • assesses and prioritises threats presented by weeds and feral animals (i.e. new occurrences are likely to be a higher priority than those that are established) • identifies key values (e.g. important springs, fauna nesting and roosting sites) that are most vulnerable to the impacts of weeds and feral animals and prioritises them for protection • maintains dune vegetation cover in the Eighty Mile Beach coastal reserves and investigates opportunities to revegetate designated areas of weed cover with native species • maintains or reduces the densities of feral herbivores (e.g. regular, late dry season aerial cull, with a focus on the freshwater springs where camels and donkeys congregate) • outlines hygiene, quarantine and surveillance procedures (e.g. clean down of machinery, vehicles and equipment used in the reserves) to reduce introduction and spread of weeds and feral animals.
	Plan and implement fire management for the planning area as part of a landscape-scale program that: • protects key values including fire sensitive ecosystems (e.g. the central peaty areas of mound spring communities) • reduces the area burnt by late dry season fires • creates a fine-scale patch mosaic of different seral stages (fuel ages) • integrates fire management planning with efforts in adjacent IPAs.
	Where feasible, establish and maintain a strategic system of protective fire breaks and access tracks for fire management, with a focus on areas of high conservation value, sites of cultural significance and other community assets (e.g. boundary fences and neighbouring properties).
	Identify, and where practicable protect, corridors, microhabitats and landform features suitable for species migration and refugia in response to extreme events and climate change.
	Develop recovery plans for threatened and priority communities in the planning area and implement recovery actions for listed species and communities (in accordance with approved recovery and conservation plans where they exist).
	Work with the appropriate bodies (e.g. Wetlands and Aquatic Ecosystems Sub-Committee) and technical experts (e.g. Australasian Wader Studies Group) to coordinate aerial and/or ground surveys of waterbirds in Walyarta Conservation Park during episodic flooding events.

KEY PERFORMANCE INDICATORS (KPIs)		
Performance measures	**Targets**	**Reporting requirements**
Water quality and quantity measures (e.g. nutrients, salinity, groundwater levels, flow rates, extent of surface water).	No significant change in water quality and quantity parameters (i.e. beyond natural seasonal or other cyclic variation) at selected high risk and/or high value sites.	Annually.
Level of understanding of the ecological water requirements of groundwater dependent communities and species.	The ecological water requirements of groundwater dependent communities and species in Walyarta Conservation Park and the Eighty Mile Beach coastal reserves are defined by 2022.	Every 2 years.
Areal extent, condition and number of occurrences of key vegetation assemblages (e.g. inland mangroves and melaleuca thickets in Walyarta Conservation Park, dragon trees in Kurriji Pa Yajula Nature Reserve).	• At least 90 per cent of the areal extent of key vegetation assemblages maintained at the same or improved condition (determined using Bush Forever condition scales) over the life of the plan. • No loss in the number of occurrences of key vegetation assemblages.	Every 3 years.
Greater bilby presence and abundance.	• No decline in bilby occupancy rates and numbers from baseline levels over suitable habitat in the first three years of implementation. • An increase in bilby occupancy rates and numbers over suitable habitat over the next five years of implementation.	Annually for the first 5 years, then reduced to every 2 years once a positive response is established.
Proportion of each reserve within the planning area burnt by late dry season fires.	No more than 20 per cent of each reserve within the planning area to be burnt per annum by late dry season fires.	Annually.
Extent (fire season, frequency and area) to which fire sensitive ecosystems are burnt.	Central peaty areas of mound spring communities remain unburnt (or fire intervals of > 20 years).	Every 3 years.
Diversity and distribution of seral stages.	A fine-scale mosaic (i.e. patches <6000ha) of seral stages including recently burnt and long unburnt patches that provide suitable habitat diversity for bilbies and other fauna over the life of the plan.	Every 5 years.

5. People on country (recreation, tourism and community values)

Parks and Wildlife and traditional owners support the concept of 'healthy parks, healthy people' and endeavour to safely facilitate people's enjoyment and recreational use of the lands and waters that they manage while still looking after other values that occur there. Over the life of the plan, recreation and tourism activities will likely be focused on the adjoining Eighty Mile Beach Marine Park. Visitor opportunities, constraints and management in the planning area are discussed in more detail below.

5.1 Planning for visitor use

The planning area is in Tourism Western Australia's 'North West' region. It is dissected by the Great Northern Highway, however visitation is limited due to the isolation of Kurriji Pa Yajula Nature Reserve, coupled with large parts of the planning area historically being pastoral land.

Eighty Mile Beach and Cape Keraudren Coastal Reserve are popular stopovers and holiday destinations for travellers between Broome and Port Hedland, providing some indication of visitor use in the vicinity. Most visitors arrive during the dry season (May to October) to enjoy the remote atmosphere and panoramic vistas, boating, recreational fishing, camping, four-wheel driving and wildlife viewing (Department of Parks and Wildlife 2014). The recent establishment of the marine park is likely to attract more visitors and may create demand for visitor facilities and activities in the planning area.

The coast will be the focus for visitation (especially around existing nodes at Cape Keraudren and Eighty Mile Beach Caravan Park). These points provide access to the distinctive seascapes of the marine park, and offer the best opportunities for visitors to experience and enjoy the natural environment. Importantly, the existing nodes provide the safest options for visitors.

With its value predominantly nature-based, any recreation activities and/or facilities within the planning area should be:

- low impact and compatible with the area's values
- appropriate to visitor demand
- consistent with *Policy Statement No. 18 –Recreation, tourism, and visitor services* (Department of Environment and Conservation 2006).

Beach spinifex, Kujungurru-Warrarn Nature Reserve.
Photo – Chris Nutt/Parks and Wildlife

Access opportunities and constraints, funding and resource availability, and provision of visitor facilities/activities elsewhere in the surrounding area are other important factors in planning for visitor use.

Eighty Mile Beach Caravan Park, Cape Keraudren Coastal Reserve and Pardoo Station (located near the south-western extent of the marine park) comfortably accommodate all overnight stays. Camping requirements are not expected to exceed current provisions over the life of the plan. Day use facilities that may be suitable in the planning area include boardwalks, lookouts and bird hides.

5.2 Access

The remote nature of the planning area, together with numerous unsealed tracks, many of which traverse private property, restrict public access to the reserves.

In the southern half of the Eighty Mile Beach coastal reserves, there are only two major public roads (Cape Keraudren Road and Eighty Mile Beach Road) that lead from Great Northern Highway to the coast, allowing access to this part of the planning area. Four-wheel driving is permitted on Eighty Mile Beach, though generally limited to the area adjacent to Eighty Mile Beach Caravan Park (i.e. between about 6km south and 18km north of the beach access point). Some visitors drive along the beach and access the Eighty Mile Beach coastal reserves by traversing the coastal dunes, however, vehicles are not permitted in these reserves (see **Access management** below).

Tyre tracks across a salt pan, Kurriji Pa Yajula Nature Reserve. It takes several days to reach the reserve from the Great Northern Highway.
Photo – Stephen Reynolds/Environs Kimberley

The western boundary of Walyarta Conservation Park is defined by the Great Northern Highway, the only major sealed road in the vicinity.

There is no other formal public access to the planning area and attempts to reach the reserves could be detrimental to visitor safety. Access to Kurriji Pa Yajula Nature Reserve, in particular, is extremely difficult and dangerous due to its remote location in the Great Sandy Desert.

Traditional owners have expressed concern about the difficulties in accessing the planning area to undertake customary activities (see the section **Connection to country**).

The Karajarri traditional owners have developed a permit system to manage visitor access to coastal recreation sites in the Karajarri IPA. These sites are located outside the planning area.

Access management

The limited access to Eighty Mile Beach has led to unauthorised off-road driving and camping in the Eighty Mile Beach coastal reserves to reach selected and isolated fishing spots or other smaller pastoral station tracks that are not open to the public. This has adverse impacts on important cultural heritage sites and practices, which are a key concern for the area's traditional owners. The practice can destroy fragile coastal vegetation, impact turtle nesting sites, disturb migratory shorebirds, and potentially introduce or spread exotic species. It can also disturb stock and disrupt pastoral operations on surrounding lands.

There are no 'permitted areas' for off-road vehicles under the *Control of Vehicles (Off-road Areas) Act 1978* in the Eighty Mile Beach coastal reserves. As such, the use of all vehicles (licensed and unlicensed), including motorbikes, quad bikes and dune buggies is not permitted in the reserves.

Other unauthorised activities that can cause disturbance and risk to key values and other visitors include campfires, littering, physical damage to cultural heritage sites and artefacts, and general inappropriate behaviour.

5.3 Safety

The planning area experiences extreme temperatures, tropical cyclones and flooding, and has remote and challenging terrain with limited communications and emergency assistance.

Visitor safety will be managed in accordance with *Policy Statement No. 53 – Visitor risk management* (Parks and Wildlife 2015) and will include dissemination of information to visitors about safety risks and personal preparedness. Through their laws and customs, traditional owners also have a responsibility to keep visitors safe on country.

5.4 Visitor information, education and interpretation

Visitor information, education and interpretation will raise awareness about the planning area, engender support for its management, and encourage community involvement and appropriate behaviour.

Visitor information, education and interpretation within, or in the vicinity of, the planning area may cover:

- cultural heritage (place names, stories and language) and natural (significant wetlands, flora and fauna, ecological communities and Ramsar) values
- management issues and management intent
- relevant cultural laws and protocols
- appropriate visitor use and visitor safety
- research and monitoring findings
- opportunities for community involvement.

Several communication and education messages could be given priority, including:

- the cultural significance of the planning area and the traditional owner associations with the area's wetlands;
- the importance of the coast for migratory birds and nesting turtles, the effects of disturbance, and steps the community can take to minimise disturbance to migratory birds and turtles; and
- the need for a collaborative approach to address key issues such as introduced herbivores and inappropriate fire regimes.

Nyangumarta elder Margaret Rose with saltbush, Walyarta Conservation Park. The cultural significance of the planning area is a key communication message. Photo – Matt Fossey/Parks and Wildlife

In addition to signage, information bays, publications, the Parks and Wildlife website and other electronic media, Parks and Wildlife encourages its own staff, traditional owners, neighbouring land managers, commercial tour operators, conservation groups and the wider community to disseminate this information.

5.5 Commercial operations

Commercial concessions, such as licences and leases for commercial operations, provide opportunities for private businesses to offer tourism and recreation opportunities, facilities and services to the public. Licences allow commercial operators to enter and use lands and waters managed under the CALM Act to conduct activities such as guided walks and tours. Leases can be granted for commercial services that occupy land, require exclusive rights of access and require substantial infrastructure.

Commercial concessions are granted in consultation with the Conservation and Parks Commission and traditional owners through the JMBs, and must be consistent with the purpose of the planning area, the protection of its values, the conditions of Parks and Wildlife's *Commercial operator handbooks* and the objectives of this plan. Most importantly, natural values must be maintained and cultural heritage protected and respected including associated site restrictions and protocols.

Parks and Wildlife encourages traditional owners to develop commercial opportunities that celebrate Aboriginal culture on land that the CALM Act applies to. While there are no existing commercial concessions relevant to the planning area, the Nyangumarta people have expressed an interest in cultural ecotourism opportunities and a desire to develop an interpretive centre near Eighty Mile Beach Caravan Park (NWAC and YMAC 2015). Given the area's proximity to the Great Northern Highway, potential exists for traditional owners to lead and operate dry season tours in Walyarta Conservation Park from Sandfire Roadhouse or Eighty Mile Beach Caravan Park to view the springs in the western part of the reserve and the inland mangroves of Salt Creek.

Nyangumarta elder Teddy Hunter at Salt Creek, Walyarta Conservation Park. The planning area may provide cultural ecotourism opportunities over the life of the plan. Photo – Parks and Wildlife

5.6 Community involvement

In addition to joint managers, neighbouring land managers and relevant government agencies, involving the wider community is integral to the development and implementation of this plan. It increases the capacity to undertake works programs, research and monitoring, and fosters communication links, sense of place and understanding within the community.

Non-government organisations, research institutions, tour operators and volunteers are key groups within the community that contribute to management of the planning area through programs such as revegetation, weed control, flora and fauna surveys, interpretation and development of visitor facilities. Several of these groups have already provided input to this planning process and others are expected to provide their views and feedback through the public comment period for this plan (see **Invitation to comment**).

Through other projects in the planning area, traditional owner groups have built productive working relationships with a range of organisations and institutions including Yamatji Marlpa Aboriginal Corporation, Kimberley Land Council, BHP Billiton, Greening Australia, Rangelands NRM and La Trobe University.

Summary of management directions for recreation, tourism and community values

Key points and considerations
• The creation of new reserves may result in increased interest in visiting the planning area. Visitation will be focused on the adjacent marine park and accessible locations along the coast. • Authorised public access to the planning area is limited. Most tracks are unsealed and traverse private property. There is currently no visitor access to Kurriji Pa Yajula Nature Reserve or Walyarta Conservation Park. • Unauthorised vehicle access along the dune system is a management issue and damages coastal vegetation and landforms, and impacts fauna and cultural heritage sites. Vehicles (including motorbikes, quad bikes and dune buggies) are not permitted in the Eighty Mile Beach coastal reserves. • The remote nature of the planning area, combined with the harsh terrain, high daytime temperatures and the occurrence of tropical cyclones, pose a risk to the safety of visitors. • Appropriate education and interpretation will increase public awareness of the values of the planning area, and promote responsible behaviour. Where cultural information is available, visitors should have greater understanding of and respect for cultural values, laws and protocols. • External organisations and community groups may be encouraged to undertake and support on-ground works, research and monitoring.

Management objectives	Strategies
1. Provide and promote appropriate vehicle access for cultural, recreation and management purposes without impacting on the values of the planning area. 2. Minimise safety risks to visitors to the planning area. 3. Enhance visitor enjoyment and appreciation of the values of the planning area and encourage behaviour that assists with management. 4. Promote and facilitate community involvement in the management of the planning area.	Maintain roads and tracks that provide public and management access.
	Close and re-route (and where feasible, rehabilitate) unnecessary or inappropriate access routes (i.e. tracks not needed for public access or management purposes or where unauthorised camping is apparent) or apply access restrictions to areas where key values are vulnerable to disturbance (e.g. threatened species and communities, sites of cultural significance and measures consistent with the marine park management plan).
	Ensure that visitor risk management for the planning area is considered as part of a regional risk management program that includes: • measures to mitigate the main and most serious safety issues • cultural laws and protocols regarding visitor risk and safety.
	Investigate the need for, and prepare and implement as appropriate, specific education and interpretation strategies that communicate: • the importance of the values of the planning area • appropriate behaviour to reduce human impacts and ensure public safety • the purpose of access restrictions and other regulations • key research and monitoring findings where appropriate.
	As visitor demand requires and as resources allow, investigate the feasibility of providing some basic visitor infrastructure (e.g. installation of shelter and interpretive facilities) to cater for activities such as cultural ecotourism and wildlife appreciation.
	Seek support from Eighty Mile Beach Caravan Park, other land managers accommodating visitors, and tour operators to disseminate information on key values of the planning area and to promote appropriate visitor behaviour.
	Develop specific licence conditions for commercial operators who operate in the planning area and access important cultural sites, to ensure visitation to these sites is undertaken in a culturally appropriate way.
	Investigate, and where possible support, cultural ecotourism opportunities in the planning area.
	Consider opportunities and provide support (i.e. advice, financial and/or logistical assistance) for community participation in management (including research and monitoring) of the planning area (e.g. universities, non-government organisations and community groups).
	Monitor vegetation cover in the Eighty Mile Beach coastal reserves to assess the nature and level of vehicle use and human impact on coastal communities, and take remedial action where needed.

6. Using resources from the country (sustainable resource use)

The responsible and sustainable use of natural resources in and adjacent to the planning area is recognised for its contribution to long and short-term economic, environmental and social outcomes. The main existing and potential activities associated with the planning area are pastoralism, abstraction of groundwater, and resource exploration and development.

6.1 Pastoralism

Grazing of domestic livestock outside the planning area is an accepted economic activity that produces food and fibre for the community and generates export products. Prior to mid-2015, the Eighty Mile Beach coastal reserves and a significant portion of Walyarta Conservation Park were held under pastoral lease. These areas are still subject to livestock grazing although it is a priority that the cattle and associated infrastructure be removed as soon as possible. Pastoral operations continue on surrounding lands, therefore incursion of livestock is both an existing and potential management issue.

The presence of permanent water, dense vegetation and shade has made the mound spring communities of Mandora Marsh particularly attractive to cattle. For decades they accessed the freshwater springs and impacted the site by trampling vegetation, pugging (compacting) of soil and introducing nutrients, and were a vector for the introduction of exotic pasture grasses and other weeds. Grazing by livestock alters habitat structure, negatively affecting species that depend on understorey vegetation for foraging and nesting (Martin and Possingham 2005). Stock have a long history of grazing the vegetation of the primary dunes along Eighty Mile Beach and along Salt Creek, contributing to erosion and damage to cultural heritage sites and values.

Indirect impacts include alteration of the movement and behaviour of native and introduced fauna species and altered fire, nutrient and surface water flow regimes. Weeds and introduced animals are often favoured by ecological changes arising from grazing (e.g. nutrient availability).

Research from sites with a history of pastoralism elsewhere suggests that ecological recovery can occur reasonably quickly following removal of livestock, however, the species most susceptible to pastoral impacts may have long disappeared from the landscape and may not return (Legge *et al.* 2011; Woinarski and Ash 2002).

Landscape-scale experiments involving the removal of stock are being undertaken across northern Australia to explore interactions of fire pattern with grazing regimes. Results from a study site in the central Kimberley indicate that mammal recovery after stock removal was only pronounced when fires were simultaneously managed to be lower in frequency, size and intensity (Ziembicki *et al.* 2015).

Parts of the planning area have long been subject to the adverse effects of domestic stock. Destocking is a priority to allow these areas to recover. Photo – Dave and Fiona Harvey/Naturalist Volunteers

Soil pugging by cattle at a spring, Walyarta Conservation Park. Photo – Karen Bettink/Parks and Wildlife

6.2 Water abstraction

Plans exist for future horticultural developments in the wider region and diversification of current pastoral use to include a range of more water intensive practices and activities such as irrigated agriculture and aquaculture (Hale and Butcher 2009). Abstraction of groundwater for horticulture or other developments poses a significant potential threat to the hydrology and functioning of groundwater dependent wetlands in Walyarta Conservation Park and their associated ecological assemblages, including TEC Mandora Mounds. According to Storey *et al.* (2011), water abstraction from the aquifers feeding the freshwater springs at Mandora Marsh would be extremely detrimental and could lead to their loss. This would also threaten stygofauna communities and would have the potential to affect the ecological character of the Ramsar site (see **Appendix I**).

Parts of the planning area are at risk of acid sulfate soils occurring near or beyond the natural soil surface. The effects of dewatering or disturbing them include contamination of groundwater and ecological damage to wetland ecosystems.

A portion of the planning area, including several of the Eighty Mile Beach coastal reserves and the majority of Walyarta Conservation Park, lies within the La Grange Management Area, in which groundwater allocation is managed by the Department of Water. The *La Grange Groundwater Allocation Plan* includes management triggers and specific local area management rules (e.g. no new bores can be drilled within the Ramsar site boundary at Mandora Marsh) to ensure that water abstraction will be sustainable and significant values protected (Department of Water 2010). In the allocation plan, the Department of Water commits to identifying the local investigations required to determine the ecological water requirements for sites of significance. Increasing the level of understanding about the hydrology of these parts of the planning area is an important management outcome.

Current abstraction is well below the annual limit, with around 35 per cent of the water in the La Grange South subarea licensed and committed as of December 2014. Spatial distribution of abstraction wells may also be an important consideration for parts of the planning area (J. Rutherford *pers. comm.* 2015).

6.3 Mineral and petroleum exploration and development

The region has identified (and prospective) mineral and oil resources that are important to the economy. At the time of publication, large parts of the planning area are of interest to the mining and petroleum industries, with live tenements covering portions of the Eighty Mile Beach coastal reserves and petroleum exploration permits extending over Kurriji Pa Yajula Nature Reserve, the northern portion of Walyarta Conservation Park and one of the Eighty Mile Beach coastal reserves.

Exploration and development proposals relevant to the *Mining Act 1978* and the *Petroleum and Geothermal Energy Resources Act 1967* must undergo the necessary environmental and heritage assessments. They may be specifically referred to the Environmental Protection Authority for environmental impact assessment, and approval under the EPBC Act may also be required where potential significant impacts on matters of national significance (e.g. Ramsar sites or listed species) are identified. Although it is unlikely that mining would be permitted within environmentally sensitive parts of the planning area, mining and exploration in the wider region has the potential to impact on key values.

Local and state government agencies may require the extraction of basic raw materials (such as gravel, shale, clay, sand, limestone and rock) for use on roads, trails and foundations for infrastructure. Due to the area's landforms (wetlands and dunes vulnerable to erosion), conservation value and low demand for visitor facilities, basic raw material extraction is unlikely to be sourced from, or supported for, the reserves. Where basic raw materials are sourced from within the planning area, the materials should only be used to contribute to the protection or management of the reserves.

Summary of management directions for sustainable resource use

Key points and considerations	
• The Eighty Mile Beach coastal reserves and a significant portion of Walyarta Conservation Park have long been subject to livestock grazing. The planning area will soon be destocked but grazing will continue on surrounding lands. • Access by cattle has impacted the coastal dunes, inland mangroves and mound spring communities. Managed and unmanaged stock are the most significant threat to the condition of the mound springs at Mandora Marsh. • Other land uses in the vicinity of the planning area include intensive horticulture, mining and petroleum exploration. An increase in groundwater abstraction associated with these activities may impact the hydrology of the planning area and groundwater dependent ecosystems.	
Management objective	**Strategies**
1. Protect key values of the planning area from adverse impacts of resource use.	Facilitate the removal of livestock and associated infrastructure from former pastoral lease areas of the planning area.
	Investigate the need for and feasibility of installing and maintaining cattle-proof fencing to exclude livestock from sensitive sites and locations (e.g. mound springs of Walyarta Conservation Park).
	Undertake regular surveys of feral stock abundance and the integrity of fencing around sensitive sites where cattle still occur.
	Consider requirements and opportunities for active control of livestock (e.g. mustering off reserves and aerial culls) as part of a regional feral animal control program (also see **Caring for country**).
	Collaborate with the Department of Water to define the ecological water requirements for significant groundwater-dependent wetlands of the Eighty Mile Beach coastal reserves and Walyarta Conservation Park (also see **Caring for country**).
	Consider the possibility of encountering acid sulfate soils and avoid disturbing, compacting, dewatering and displacing saturated soils at risk.
	Work with the relevant agencies to evaluate land use, exploration and development proposals that may impact on the key values of the planning area and seek to avoid or minimise these impacts.
	Provide advice to ensure that any sites disturbed by resource exploration and development within the planning area are rehabilitated in accordance with the conditions of the mining or exploration tenure or approval documentation, as well as Parks and Wildlife rehabilitation standards and guidelines.

7. Performance Assessment

The Conservation and Parks Commission has responsibility for assessing the implementation of this plan in accordance with section 19(1)(g)(iii) of the CALM Act.

Progress towards achieving the objectives of the plan is demonstrated by regular monitoring, evaluation and reporting to investigate the effectiveness of management strategies and identify opportunities for improvement. These are key elements of an adaptive management framework, enabling strategies to be revised where needed. A set of key performance indicators (KPIs) will be used to assess the implementation and success of this plan.

The KPIs (comprising performance measures, management targets and reporting requirements[4]) have been identified for selected values and management issues and are presented in the relevant management tables throughout the plan. The KPIs are linked to objectives and strategies, and reflect the highest conservation and management priorities of the Conservation and Parks Commission, Parks and Wildlife, joint management partners and the community. Any sustained change (e.g. a continuous decrease or increase) will trigger the need for further investigation to determine the cause of that change and therefore the requirement for, and type of, management intervention.

Providing accurate and relevant data and information as evidence of plan implementation is essential to ensure the assessment process is performed quickly and effectively. A portfolio will be maintained showing evidence of those areas where the plan is being successful and those where changes are needed. Some examples of evidence that may be used to assess implementation of this plan include:

- specific, quantitative monitoring of significant assets such as conservation significant flora and fauna and TECs
- series of photographs, mapping or other imagery that show whether spatial and temporal changes have occurred
- checklists
- surveys
- incident reports or records
- other written documents or correspondence.

Assessment by the Conservation and Parks Commission should also be informed by monitoring and reporting under the Karajarri Healthy Country Plan and the Nyangumarta Warrarn IPA plan.

Footprints, Kujungurru Warrarn Nature Reserve.
Photo – Matt Fossey/Parks and Wildlife

[4] While reporting requirements may be annual (or other), determining reliable trends might not be possible for a number of years.

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Appendices

Appendix I: Eighty Mile Beach Ramsar site

The Eighty Mile Beach Ramsar site was listed as a wetland of international importance under the Ramsar Convention on 7 June 1990. The site covers two separate and distinct areas, totalling 175,487ha: Eighty Mile Beach and associated intertidal flats and primary dunes (known as the beach section) and Mandora Marsh. The beach section is largely protected by the Eighty Mile Beach coastal reserves and the adjacent marine park and Walyarta Conservation Park covers the majority of Mandora Marsh. Small areas of the Ramsar site occur on pastoral lease outside the formal conservation estate.

The planning area formally protects a significant portion of the Eighty Mile Beach Ramsar site. Photo – Parks and Wildlife

Ramsar listing criteria

To qualify for listing, a wetland must meet at least one of the nine Ramsar criteria. The Eighty Mile Beach Ramsar site currently meets criteria 1-6.

Table 5 Listing criteria met by portions of the Ramsar site in the planning area

Group A of the criteria: Sites containing representative, rare or unique wetland types	
	Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region. • Mandora Marsh, within the Great Sandy Desert bioregion, contains an important and rare group of wetlands, including periodically inundated lakes, a permanent hyper-saline creek, freshwater, tree-dominated wetlands, and freshwater and saline mound springs.
Group B of the criteria: Sites of international importance for conserving biodiversity	
Species and ecological communities	**Criterion 2:** A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities. • The greater bilby, listed as Vulnerable under the Wildlife Conservation Act and the EPBC Act, has been recorded at Mandora Marsh. • The coastal dunes and inland wetlands support several threatened shorebird species including the Australian painted snipe, bar-tailed godwit, curlew sandpiper and greater sand plover. • The dunes of Eighty Mile Beach provide nesting habitat for the flatback turtle, listed as Vulnerable under the Wildlife Conservation Act and the EPBC Act. • One threatened ecological community and one priority ecological community are located at Mandora Marsh.
	Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region. • Mandora Marsh contains temporary and permanent wetlands recognised as important refugia for biodiversity in a predominantly arid bioregion. In particular, the mound springs make a significant contribution to the regional diversity of flora and fauna.
	Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions. • When flooded, Mandora Marsh supports the critical life stage of breeding for at least 13 waterbird species, including large numbers of Australian pelicans (*Pelecanus conspicillatus*) and black swans (*Cygnus atratus*). • Eighty Mile Beach is one of the major stopover and non-breeding areas for migratory shorebirds visiting Australia. Many of these feed almost exclusively on the intertidal flats of the marine park, but use the coastal reserves for roosting at high tide. • The coastal dunes also support flatback turtle nesting.
Waterbirds	**Criterion 5:** A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds. • The beach section, including the coastal reserves, is considered to regularly support in excess of 500,000 birds. • There are records of large numbers (i.e. > 20,000) of waterbirds associated with flooding at Mandora Marsh, though on an infrequent basis.
	Criterion 6: A wetland should be considered internationally important if it regularly supports one per cent of the individuals in a population of one species or subspecies of waterbird. • Maximum counts for at least two resident waterbirds – the black-winged stilt (*Himantopus himantopus*) and Eastern great egret (*Ardea modesta*) – at Mandora Marsh exceed the one per cent population thresholds. • Maximum counts in the beach section exceed one per cent of the flyway population (or one per cent of the Australian population for resident species) for 21 waterbird species.

Critical components and processes

Under the Convention, Contracting Parties commit to promoting the conservation of listed wetlands, with the aim of preventing changes to their ecological character. Ecological character is determined by key physical, chemical and biological components and processes. The critical components and processes for the Eighty Mile Beach Ramsar site, as identified by Hale and Butcher (2009), are listed below:

Beach section
Hydrology
Geomorphology
Primary production
Invertebrates
Fish
Waterbirds
Turtles

Mandora Marsh
Hydrology
Geomorphology
Water quality
Phytoplankton and primary production
Vegetation
Invertebrates
Waterbirds

While the components and processes of the beach section have relevance to the Eighty Mile Beach coastal reserves, their management and monitoring is generally dealt with by the marine park management plan.

Limits of acceptable change

Parks and Wildlife is the lead agency for implementation of the Ramsar Convention in Western Australia and part of this responsibility involves reporting to the Australian Government if the ecological character of the Ramsar site has changed, is changing or is likely to change. To assist with this, limits of acceptable change and interim limits of acceptable change were set by Hale and Butcher (2009) but these will need to be reviewed as information is gained from future monitoring. To ensure that limits of acceptable change are not exceeded, operational limits may need to be identified as early warning triggers. Where an operational limit is reached, management should intervene to determine whether the change is detrimental and, if required, prevent further deterioration.

Research and monitoring in Walyarta Conservation Park will enable limits of acceptable change and operational limits to be set and reviewed for the critical components and processes of Mandora Marsh. If it is not possible or practical to set limits for all components and processes, priority should be given to those which are the primary determinants of ecological character (e.g. hydrology) and those which can be managed and monitored (e.g. water quality and vegetation).

Reporting

Parks and Wildlife is responsible for reporting on the condition and status of the ecological character of the Eighty Mile Beach Ramsar site every three years, as part of a rolling review. The department's Wetlands Section will coordinate the triennial review and reporting to the Australian Government.

Appendix II: Physical and biological environment

Climate

The climate of the planning area is semi-arid monsoonal with a prolonged dry season between April and November. Temperatures range from warm to hot year-round and, on average, evaporation greatly exceeds rainfall. The Eighty Mile Beach coastal reserves receive an average rainfall of 370mm decreasing further inland to 300mm at Walyarta Conservation Park and about 250-200mm at Kurriji Pa Yajula Nature Reserve. Much of the rain comes from thunderstorms and the proximity of cyclones (Willing 2014).

Tropical cyclones frequently impact the region, most commonly during the wet season (December to April), bringing extremely strong winds and torrential rainfall. This can have dramatic effects on the landforms and ecology of the planning area. Flooding is sometimes associated with these cyclonic events and is enhanced when multiple tropical lows occur within a few weeks of each other. As the cyclonic centres move across land, their strength diminishes and wind speeds abate.

Geomorphology and landforms

In geological terms, the planning area is situated in the southern part of the Canning Basin. The entire area is part of a large palaeodrainage system called the Wallal Paleoriver that extends from the Northern Territory, through the eastern Kimberley, to Eighty Mile Beach on the coast (Wyrwoll *et al.* 1986). The geomorphology or contemporary landscape is influenced by a combination of deep-seated geological structures and external fluvial and aeolian processes.

Fluctuations in mean sea level have also had a major impact on the local landscape, with the most recent occurring around 10,000 years ago when the wetlands of Walyarta Conservation Park and the coastal plains that back Eighty Mile Beach existed as a shallow marine system. At this time, these wetlands were probably part of an estuary at the mouth of the Wallal Paleoriver (Watkins *et al.* 1997). This is reflected by the fine, carbonate-dominated lithology of the area (Semeniuk 2008). The retreat of the sea level and its recent relative stability enabled sand dunes to build up along the coastline. Carbon dating of the sediments of Eil Eil Spring in Walyarta Conservation Park and Dragon Tree Soak in Kurriji Pa Yajula Nature Reserve suggests that these landscape features formed about 7000 years ago, and have been geographically isolated since (Wyrwoll *et al.* 1986).

Eil Eil Spring, Walyarta Conservation Park. Photo – Jan van de Kam

The dunes of the Eighty Mile Beach coastal reserves are comprised of coarse sand, dominated by calcareous sediments of marine shell origin (Pearson *et al.* 2005). The southern sections of the shoreline are characterised by calcarenite bluffs, 3-5m in height. There are also a small number of shallow tidal creeks that dissect the dunes in the south.

The wetlands of Walyarta Conservation Park are surrounded by linear dunes of red quartz sand. The floor of the two large, periodically inundated wetlands comprise sand, silt and clay of alluvial origin. To the south and north of these (but more extensive in the south) are areas of clay soil that retain surface water for longer than the surrounding landscape. There are also significant rocky exposures of calcrete. The mound springs contain peat soils, accumulated over thousands of years.

The dominant landforms of Kurriji Pa Yajula Nature Reserve are the sandplains and dunes, comprising longitudinal dunes of red quartz sand with a predominant east-west trend and the plains between them. The two mound springs, Dragon Tree Soak and the smaller Elizabeth Soak, contain black peaty mud and are situated in a series of claypans.

Hydrology

Walyarta Conservation Park principally comprises the Mandora Marsh wetland complex, which includes a number of wetland types. The predominant features are two large, periodically inundated wetlands, Lake Walyarta and East Lake. Salt Creek is a braided saline channel system between the two lakes that is predominantly groundwater fed, but after heavy rain carries surface water east to west into Lake Walyarta. At other times the creek exists as a series of isolated pools (Hale and Butcher 2009). The Mandora Marsh complex also contains a series of permanently wet mound springs that vary in size from 0.1 to several hectares and are located along the southern side of the two main wetlands. These are characterised by a thick mound of saturated peat, topped by dense vegetation and surrounded by either an inundated moat or tail.

The diverse range of wetlands that occur in the reserve reflects the different water balance requirements that occur within the complex The most important hydrological input for Lake Walyarta and East Lake is surface run-off flow during periods of cyclonic activity. Flooding events are significant in directly providing habitat for aquatic organisms and a breeding site for many waterbirds (Halse *et al.* 2005). However, in the majority of years the lakes are either dry or after partial inundation they dry to form bare clay beds surrounded by saltmarsh. Importantly for the freshwater springs, flooding within the upgradient dunes and swale systems is also likely to be important in encouraging groundwater recharge within aquifers beneath the wetlands.

Groundwater is a significant component of the hydrology of Walyarta Conservation Park. The Broome Sandstone aquifer is believed to be an important groundwater system and is thought to sustain many of the freshwater mound springs, while at some springs the Wallal aquifer is likely to also play a role in spring resilience due to groundwater movement along geological faults (J. Rutherford *pers. comm.* 2015). A lesser contribution to the hydrology of the reserve is the input of discrete channelised flow from Salt Creek (Department of Environment and Conservation 2012). This waterway appears to be fed through a series of springs from a saline aquifer (Graham 1999). Salt Creek is an important wetland in its own right as it supports a unique mangrove community, which is thought to depend on springs in the area producing water of similar salinity to seawater (Willing 2014).

Kurriji Pa Yajula Nature Reserve contains two permanent mound springs, which lie about 2km apart. The soaks and fringing permanent swamps are small in size but are regarded as oases within the Great Sandy Desert. Hydrology is believed to be dominated by shallow aquifers within the Wallal Paleoriver, which supplies a continuous supply of groundwater (Wywroll *et al.* 1986). The mound springs occur where the groundwater discharge reaches the surface (Spurr 1996). Major rain events, such as those associated with cyclones, presumably recharge aquifers and flood the surrounding claypans for short periods.

Flora

Diverse vegetation associations occur within the planning area, reflecting its location in both the Dampierland and Great Sandy Desert bioregions, and the fact that it includes areas on the coast and hundreds of kilometres inland. At a very broad scale, much of the vegetation of the planning area is mapped as hummock grassland, while parts of Walyarta Conservation Park are categorised as tall shrubland and samphire (Beard *et al.* 2013).

The primary dunes of the Eighty Mile Beach coastal reserves are generally sparsely vegetated with beach spinifex (*Spinifex longifolius*), grey soft spinifex (*Triodia epactia*) and the hardy sedges *Fimbristylis cymosa* and *Fimbristylis serica*. Creepers, shrubs and low herbs occur on the secondary dune ridges and swales, including thickets of dune wattle (*Acacia bivenosa*). Some small tidal creeks near Mandora station support two minor mangrove stands. Samphire communities are known to occur in the vicinity (Johnstone 1990).

The co-occurrence of saline and freshwater wetlands in Walyarta Conservation Park gives rise to unique and unusual vegetation associations, with plants that are able to tolerate saline conditions occurring in close proximity to species reliant on fresh water. In some areas for example, grey mangroves have a close association with freshwater species such as dragon trees and bulrush (*Typha domingensis*).

The grey mangrove community of Salt Creek is more than 50km from the coast and represents one of only two such communities in Australia, the other being at Lake Macleod. It has been suggested that this is a relict stand from a time when sea levels were higher. A few mangroves also occur on the more brackish springs (e.g. Fern Spring).

The freshwater mound springs contain a complex mosaic of vegetation associations (e.g. Department of Environment and Conservation 2009) and provide a sharp contrast to the surrounding shrub steppe. Tall stands of paperbark (*Melaleuca leucadendra* or *Melaleuca cajuputi*) and dragon trees grow on the peat mounds and make the springs stand out on the landscape. Under this is often a dense ground cover of the mangrove fern (*Acrostichum speciosum*). Also present are stands of bulrush, sedgelands dominated by *Schoenoplectus* species, rusty sedge (*Fimbristylis ferruginea*), and patches of saltwater couch grass (*Sporobolus virginicus*). Not only is the dominant vegetation of the various springs variable between occurrences, it is variable over time as the area is frequently subject to cyclones.

Tall stands of paperbark are associated with many of the freshwater mound springs of Walyarta Conservation Park. Photo – Jan van de Kam

Lake Walyarta and East Lake are generally bare of vegetation, or support low open shrublands of samphires dominated by *Tecticornia* spp. When flooded, they contain a mix of submerged aquatic species including ribbon weed (*Vallisneria spiralis*) and freshwater macroalgae (Graham 1999). The extensive alluvial plains to the north and south of these wetlands support low woodlands or shrub thickets of saltwater paperbark (*Melaleuca alsophilia*) and *Acacia ampliceps*, over low shrubs such as *Acacia monticola*. The surrounding red sand dunes and sandplains support a selection of pindan and desert plant species.

Kurriji Pa Yajula Nature Reserve has relict populations of flora not found elsewhere in the region. The centre of Dragon Tree Soak is dominated by *T. domingensis* and a small patch of jointed rush (*Baumea articulata*), which is at the edge of its extent. Two main clusters of dragon trees grow as a low forest at the northern and southern ends and scattered specimens also occur in the *B. articulata*. A dense band of taller grass *Paspalum vaginatum* exists around the soak in damp mud and a more extensive ring of *S. virginicus* surrounds this on higher, drier ground. The nearby smaller Elizabeth Soak has similar vegetation communities. Beyond the soaks, the vegetation quickly assumes that of the desert landscape, dominated by spinifex grasses, acacia and melaleuca thickets, and desert walnut (*Owenia reticulata*).

Scattered grove of desert walnut, Kurriji Pa Yajula Nature Reserve. When roasted, the nuts are a popular food for traditional owners.
Photo – Stephen Reynolds/Environs Kimberley

Fauna

Limited fauna research has been conducted in the planning area, however the rarity of aquatic habitat suggests that the reserves are significant for a range of species and populations. In particular, the permanent freshwater wetlands provide habitat for aquatic fauna year round and a source of drinking water for terrestrial animals.

The Eighty Mile Beach coastal reserves border the entire length of the beach and provide habitat value for the nesting flatback turtle and many migratory shorebirds. Acacia and melaleuca thickets support high densities of red kangaroo (*Macropus rufus*), euro (*Macropus robustus*) and agile wallaby (*Macropus agilis*). The reserves and adjacent coastal plains are regarded as a stronghold for the Australian bustard (*Ardeotis australis*).

Terrestrial vertebrate surveys of Mandora Marsh were conducted in 1999 and 2015 (Graham 1999; Jackett and Graff 2015; Parks and Wildlife 2016). Several major differences were found between species recorded, abundances and distribution, highlighting the need for further research and monitoring. Of particular significance is the presence of the greater bilby, recorded near Salt Creek as recently as September 2015 (Parks and Wildlife 2016).

Breeding colony of pelicans, black swans and straw-necked ibises in 2004, Walyarta Conservation Park. Photo – Jan van de Kam

Lake Walyarta and East Lake in Walyarta Conservation Park are important for waterbirds, including migratory species, when inundated extensively. When Lake Walyarta flooded in 1999 and 2000, it was found to be supporting around 480,000 and 490,000 waterbirds respectively (Halse *et al.* 2005), although the area surveyed included inundated land outside the boundaries of the reserve and the Ramsar site. The site is also significant for the role it plays in supporting individual waterbird species, with maximum counts exceeding the one per cent population thresholds for several species (Hale and Butcher 2009).

Mandora Marsh also supports a relatively rich aquatic invertebrate fauna, which Storey *et al.* (2011) attributed to the different types of permanent wetlands within the one location. While there were few endemic species, the springs are regionally important for maintaining virtually all aquatic invertebrates. They are believed to provide a source of invertebrates to colonise the main lake bodies when in flood (A. Pinder *pers. comm.* 2016). Given the strong link between calcrete and stygofauna already known from the Pilbara (Eberhard *et al.* 2005), the area likely supports diverse and locally to regionally endemic stygofauna communities, but these have been poorly surveyed to date. Two native fish species have been recorded from the Salt Creek system, including a new endemic species (an undescribed goby) (Hale and Butcher 2009; Storey *et al.* 2011).

Fauna surveys in Kurriji Pa Yajula Nature Reserve have mainly focused on Dragon Tree Soak itself. Bamford and Davies (1996) noted that the site had high avian species richness for an arid area. Waterbird species not recorded elsewhere in the region but present in the dense vegetation of the central sedgeland include the Australian crake (*Porzana fluminea*), clamorous reed-warbler (*Acrocephalus stentoreus*) and little grassbird (*Megalurus gramineus*) (Australian Nature Conservation Agency 1996; Charles 2004). The giant frog (*Cyclorana australis*) and at least three bat species have been recorded at the soak, along with greater bilby sign (Burbidge *et al.* 1991; Handley 1996).

The little grassbird is rare in the Great Sandy Desert but inhabits the thick reed beds of Dragon Tree Soak. Photo – CSIRO

Appendix III: Guiding principles for fire management in landscapes dominated by spinifex grasslands

1. Climate and vegetation make landscapes dominated by spinifex grasslands highly prone to fire. For thousands of years, lightning and human ignitions have ensured that fire is an environmental factor that has influenced the structure, function and biodiversity of spinifex grasslands.
2. Species and communities vary in their adaptations to, and reliance on fire. Knowledge of the ways in which species and communities respond to fire, and of the temporal and spatial scales of fires in relation to life histories of organisms or communities, underpins the use of fire.
3. Rainfall is a primary driver of the rate of fuel accumulation and subsequent flammability of spinifex grasslands, and large, extensive wildfires are usually preceded by several seasons of above average rainfall.
4. The response of species and communities to fire will be influenced by subsequent rainfall and the fire's scale and patchiness, which can drive systems towards a new transient state with respect to species composition and structure.
5. Fire management is required primarily to conserve biodiversity. In some circumstances, it may be necessary to manage fire to protect property, infrastructure and cultural values.
6. Fire management should be both precautionary and adaptive, considering the requirements of both fire sensitive (habitat specific) and fire maintained communities and species in order to optimize biodiversity conservation outcomes.
7. Landscapes dominated by spinifex grasslands are vast, remote and difficult to access. Fire management resources are scarce, so active fire management including fire suppression and prescribed burning, should focus on areas of high conservation value and on high value built and cultural assets. On much of the spinifex grasslands, passive management, including allowing unplanned fires to burn, is a realistic and acceptable management option.
8. Fire diversity can support biodiversity both at landscape and local scales. At the landscape scale, a fine grain mosaic of patches of vegetation representing a range of interlocking seral (post-fire) stages will provide diversity of habitats for organisms that are mobile and can move through the landscape. At the local scale, appropriate intervals between fire, based on vital attributes of key species, are necessary to ensure the persistence of sessile or less mobile organisms.
9. Avoid applying the same fire regime (frequency, interval, season and scale) over large areas for long periods and avoid seral and structural homogenization by not treating large areas with extreme regimes such as sustained frequent burning or infrequent burning.
10. The scale or grain size of the mosaic should a) enable natal dispersal, b) optimize boundary habitat (boundary between two or more seral stages), and c) optimise connectivity (ability of key species to migrate between seral stages).
11. Two to three years or more of above average rainfall will result in rapid growth of spinifex and flammable soft grasses, predisposing landscapes to large wildfires capable of burning through fire mosaics. While such events are infrequent, strategically located low fuel buffers 500-1000m wide may be required to contain wildfires under these conditions.
12. All available knowledge including scientific, local and indigenous knowledge should be utilized to develop ecologically appropriate fire management.
13. Consultation and partnerships with neighbours, including traditional custodians, is an effective way of managing fire for mutual benefit.
14. Fire management should be planned and implemented in an adaptive management framework. Use of tools including remote sensing and aircraft, will be essential for planning and implementing fire use and for mapping and monitoring fire mosaics and fire history.
15. As part of an adaptive management framework, biodiversity monitoring should focus on; 1) threatened species and communities, 2) fire sensitive species and communities and 3) the remaining biota. Threats such as introduced plants and animals, and abiotic processes including weather (rainfall) and fire history, must be monitored/recorded to help interpret changes in biodiversity.
16. Where spinifex grasslands have been invaded by flammable weed species such as buffel grass, which is capable of adversely altering the frequency and intensity of fire, prescribed fire should be used conservatively and strategically to break up the run of major wildfires.

Appendix IV: Climate change vulnerability assessment of mound spring communities, Walyarta Conservation Park

Description: Suite of approximately 15 mound springs in the Mandora Marsh wetland complex.

Risk assessment

Present status = **Good**

Springs are classified as evolutionary refugia because they are likely to support short-range endemic species. Biodiversity conservation value is high. Springs are protected within a Ramsar site and conservation estate.

The most significant drivers of change are livestock grazing and feral herbivores (camels). Recent surveys indicate that springs across the site have been adversely impacted by cattle. The site will soon be destocked; the threat of feral animals remains.

Risk perception

Sensitivity

Low to direct climate impacts because springs are groundwater-fed. **Very high** to indirect climate impacts (groundwater abstraction) and other stressors (e.g. degradation of habitat and water quality due to impacts of livestock and feral herbivores).

Adaptive capacity

High for habitat, **low** for endemic biota because although some springs may be more resilient to direct climate impacts due to being sustained by deeper groundwater, endemic spring biota have little capacity to recolonise if springs run dry.

Note the responses of different springs will vary (e.g. those with a higher reliance on shallow aquifer discharge are likely to show more rapid changes). The open water areas of the springs also dry out regularly and altered climatic conditions may change the periodicity of this drying.

Risk minimisation/management

Vulnerability = **Moderate**

Low vulnerability to direct climate impacts. **High** vulnerability to indirect climate impacts and other stressors.

Risk minimisation and adaptation strategies

Protect aquifers and monitor water levels in selected springs. Fence sections of the reserve adjacent to pastoral operations and undertake culling of camels and donkeys to maintain low density populations of feral herbivores. Assess degraded habitats and restore if needed. Assess new developments for potential impacts on springs and the aquifers supporting them.

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