Ord River and Parry Lagoons nature reserves

management plan 77

2012

Department of
Environment and Conservation

Conservation Commission
WESTERN AUSTRALIA

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Front cover photos
Main image: Boardwalk at Marlgu Billabong.
Top left: Green tree frog (*Litoria caerulea*).
Top right: Telegraph Hill interpretive sign.
Header photo: Green tree frog (*Litoria caerulea*).
Photos – DEC

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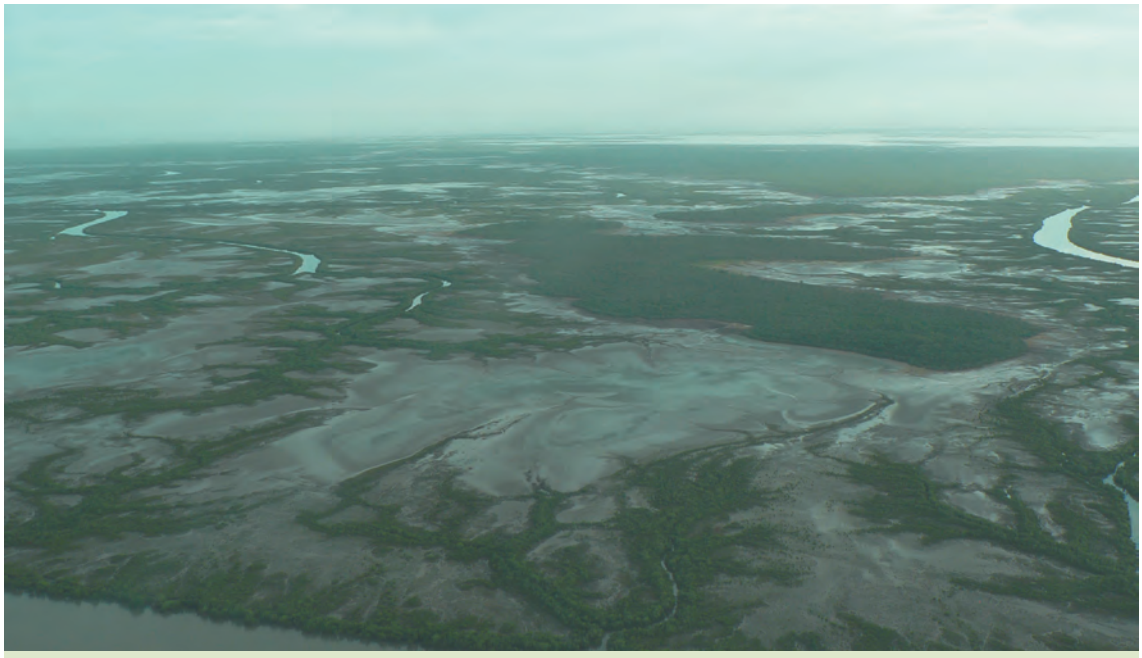
Introduction

1. Overview

The planning area is located in the East Kimberley region in the north of Western Australia (WA), within the Victoria Bonaparte bioregion. The Victoria-Bonaparte bioregion covers more than 70,000 square kilometres and spans the WA and Northern Territory borders, with more than 70 per cent of the bioregion within the Northern Territory. The Ord River catchment covers more than 64,000 square kilometres and also spans the border of the two jurisdictions, although it lies predominantly within WA. The 650-kilometre-long Ord River starts near Halls Creek and drains into the Cambridge Gulf. The planning area lies within the greater Kununurra Planning Region within the Shire of Wyndham-East Kimberley. The western boundary is about 15 kilometres east of the town of Wyndham. The eastern boundary is about 47 kilometres north-west of the town of Kununurra (see Map 1).

Ord River and Parry Lagoons nature reserves are two existing reserves to be eventually jointly managed by the Department of Environment and Conservation (DEC, the department) and Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation, through the Yoorrooyang Dawang Regional Park Council (see *Management arrangements with Aboriginal people*). As specified in the *Ord Final Agreement*, joint management is dependent on resources being available, including staffing and funding. The department and the Conservation Commission of Western Australia (Conservation Commission) are also interested in pursuing joint management arrangements for that part of the planning area that falls within the claim areas of the Balanggarra people (WC00/6 / WAD6004/2000 and WC99/47 / WAD6027/98).

Ord River Nature Reserve includes the spectacular False Mouths of the Ord, featuring vast areas of mudflats, mangrove communities and a maze of tidal creeks. Of the 18 species of mangrove found in WA, 16 have been recorded within the reserve. It is also important because of the presence of mangrove-dependent bird species not found elsewhere in WA. Additionally, lands within the planning area are considered important habitat for the saltwater crocodile (*Crocodylus porosus*).



Floodplains of the Ord River. Photo – DEC

The seasonal wetlands south of the Ord River are fresh and sometimes fringed by low shrubs or trees, which are surrounded by a flat, grass-covered plain. The mudflats along the river and the eastern side of Cambridge Gulf support patches of saline grassland and samphire. They are incised by numerous creeks and channels, along which are extensive stands of mangroves. Mangroves also grow along the Ord River and the seaward side of the mudflats.

A major characteristic of Parry Lagoons Nature Reserve is the presence of many waterbird species, often in great numbers. It also includes a variety of important habitats such as freshwater springs, components of rainforest, grasslands, woodland, rugged sandstone and floodplain. This diversity of habitat supports a rich faunal assemblage.

Water lilies on a lagoon. Photo – DEC

The planning area, in conjunction with the lower Ord River waterway, forms the Ord River Floodplain Ramsar site (see Map 1). Listed in 1990 as a Wetland of International Importance, the wetland meets seven of the nine qualifying criteria (see Appendix 1) (Hale 2008). Further information on the Ramsar site can be found in the *Ramsar Information Sheet*[1] and in the *Ecological character description of the Ord River Floodplain Ramsar site* (Hale 2008).

2. Management plan area

This management plan covers the following reserves vested in the Conservation Commission and managed by the department (Map 1).

- Ord River Nature Reserve (Reserve 31967) covers an area of 79,842 hectares.
- Parry Lagoons Nature Reserve (Reserve 42155) covers an area of 36,111 hectares.

Both the Ord River and Parry Lagoons nature reserves have the purpose ‘conservation of flora and fauna’ and are proposed to be changed from ‘class C’ to ‘class A’ nature reserves. Consideration may also be given to changing Parry Lagoons Nature Reserve to a national park, a more appropriate tenure given the level of recreation and tourism in the reserve (for example, at Marlgu Billabong).

[1] *The Ramsar information sheet can be accessed via the Australian Wetlands Database: www.environment.gov.au/wetlands*

The department has also identified other land as proposed nature reserves (see Table 1 and Map 2).

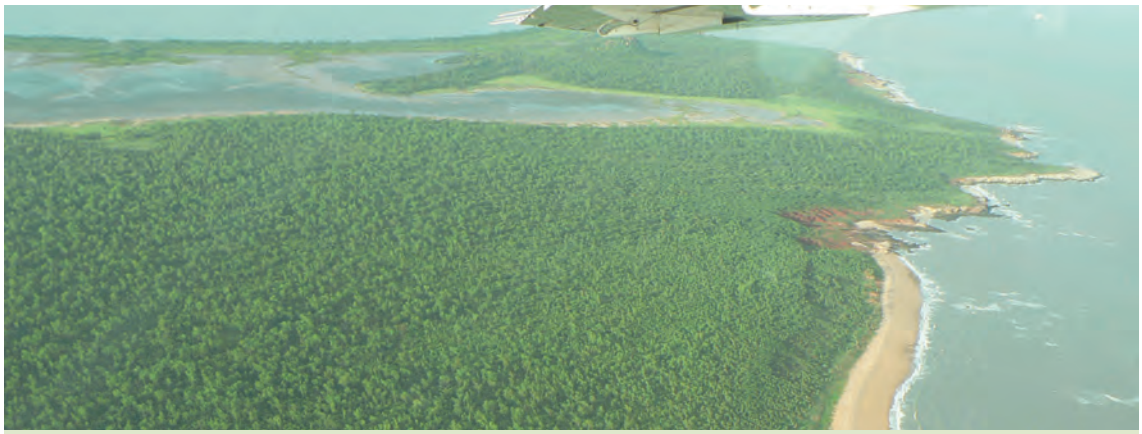
Table 1 Proposed additions to DEC-managed land

Proposed addition	Area (ha)	Current tenure	Proposed changes
Adolphus island	8,156	UCL	NR
Cape Domett	4,218	UCL	NR
40m strip between the eastern boundary of Ord River Nature Reserve and the Carlton Hill pastoral lease	1,212	UCL	NR
The boundary of Parry Lagoons Nature Reserve on the Ord River be extended to low water mark	undefined	UCL	NR
Islands within the Ord River channel to low water mark	undefined	UCL	NR

UCL = unallocated Crown land
NR = nature reserve

The proposed additions originated from *Nature conservation reserves in the Kimberley* (Burbidge et al. 1991) and from discussions with key stakeholders. Burbidge et al. (1991) further proposes the lower reaches of the Ord River, the waters adjacent to the existing nature reserve and False Mouths of the Ord to be declared as 'class A' marine nature reserve. Further to this, *A representative marine reserve system for Western Australia: report of the Marine Parks and Reserves Selection Working Group (Marine Parks and Reserves Selection Working Group* 1994) identifies areas of the Cambridge Gulf for reservation. That report also identified Cape Domett, which has been included as an addition to DEC-managed lands in this management plan. More recently, the Kimberley science and conservation strategy (Government of WA 2011) also identified the importance of protecting the flatback turtle (*Natator depressus*) rookeries at Cape Domett. Reservation of these areas would further protect significant conservation areas and would also include the remaining areas of the Ramsar site not covered by this management plan.

It is intended that the proposed reserve additions listed will come under the management plan once the change in land tenure and purpose occurs and the reserves are vested in the Conservation Commission. Any additional proposed reserves will be managed in a manner that is consistent with this management plan.



Cape Domett, a proposed addition to Ord River Nature Reserve. Photo – DEC

Any reserve additions, or changes in the classification of existing reserves or the category of land, will be subject to consultation with government.

Desired outcome

- Protect the values of the planning area.

Management actions

1. Undertake the process for a change in tenure for the Ord River and Parry Lagoons nature reserves to 'class A' nature reserves.
2. Investigate an appropriate tenure for Parry Lagoons Nature Reserve, for example, a national park category, to better accommodate future visitor needs.
3. Undertake the process for incorporating proposed additions as identified in Table 1 into the existing nature reserves.

3. Key values and threats

Key values

- Extensive representation of mudflat and tidal waterway systems at the False Mouths of the Ord, within the Victoria Bonaparte subregion of the Interim Biogeographic Regionalisation of Australia.
- An extensive and diverse mangrove community consisting of 16 of the 18 species of mangrove known to occur in WA.
- A mangrove habitat that supports several species of bird restricted to mangrove forests.
- Important habitat and breeding site for the saltwater crocodile.
- Wetland areas that regularly support more than 20,000 waterbirds at a time.
- Habitats that support critical life stages of annually migrating bird species, act as seasonal drought refuge areas for large numbers of waterbirds, and provide for breeding of 16 species of wetland-dependent birds.
- Sites important for nursery, breeding and feeding for at least 50 fish species, and a migratory route between marine and freshwater habitats for 15 species of fish.
- Cultural and heritage sites of significance for Aboriginal and other Australian people.
- Recreation and tourism activities, particularly birdwatching, fishing and boating.

Key threats

- Altered hydrological regimes (including effects from tidal power).
- Inappropriate fire regimes.
- Inappropriate recreational use.
- Introduction of environmental weeds, introduced or problem animals and diseases.
- Overfishing.
- Mineral and petroleum exploration and development.
- Agricultural development.
- Pollution (for example, degradation of water quality through the increase of nutrients such as fertilisers used for agriculture, and non-nutrient contaminants such as herbicides and insecticides).
- Climate change.

4. Management directions

The vision for the planning area is:

To be recognised by the community for its international significance as a wetland providing for migratory and local waders, waterbirds and shorebirds, and as a place where natural, cultural and aesthetic values are appreciated and protected. Natural systems and processes will continue to function, and habitats will be managed in partnership with traditional owners and the community to maintain and improve the area's Ramsar and other natural values.

This management plan has been prepared as required under the *Conservation and Land Management Act 1984* (CALM Act). It is guided by relevant department policies and provides a summary of operations proposed to be undertaken in the planning area, as required under the CALM Act, to protect and enhance values of the planning area. This plan informs subsidiary operational documents that provide more management detail regarding fire response, weed and introduced animal control, and recreation site maintenance.

This management plan is consistent with Australia's obligations under the Ramsar Convention on Wetlands and promotes the management of the Ord River Floodplain Ramsar site in accordance with the Australian Ramsar management principles.

Parry Lagoon. Photo – DEC

Management purpose

5. Legislative framework

In addition to the CALM Act, the department administers other legislation that is relevant to the protection of native flora and fauna such as the *Wildlife Conservation Act 1950* (Wildlife Conservation Act) which provides for the conservation and protection of wildlife. Other relevant legislation administered by the department is listed on the State Law Publisher's website.[2]

Australia is a participant or signatory to the following important international conservation agreements, which affect the management of the planning area:

- Convention on Wetlands of International Importance especially as Waterfowl Habitat (known as the Ramsar Convention)
- China-Australia Migratory Bird Agreement
- Japan-Australia Migratory Bird Agreement
- Republic of Korea-Australia Migratory Bird Agreement
- Convention of Migratory Species of Wild Animals (known as the Bonn Convention).

The Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), through the Environment and Biodiversity Conservation Regulations 2000, prescribes general standards for Ramsar wetlands in Australia such as requirements for management planning and environmental impact assessment[3] (Schedule 6, regulation 10.02).

The Ord Final Agreement is an agreement between the state government and the Miriuwung and Gajerrong people resolving native title over traditional lands. An outcome of the Ord Final Agreement was to establish processes to provide consultation with Aboriginal people and their interaction in management and planning (see *Management arrangements with Aboriginal people*).

6. Management arrangements with Aboriginal people

There is strong interest by Aboriginal people to be involved in the management of CALM Act reserves and to strengthen cultural ties to the land. Working together with Aboriginal people to care for the land will be beneficial to the preservation of natural and cultural heritage, as well as enriching cross-cultural awareness.

The department and the Conservation Commission acknowledge the aspirations of Aboriginal people to obtain native title over their traditional lands and waters under the provisions of the federal government's *Native Title Act 1993* (Native Title Act).

Portions of the Ord River and Parry Lagoons nature reserves are traditional lands for the Balanggarra people and the Miriuwung Gajerrong people. While native title for the Miriuwung Gajerrong lands has been determined through the Ord Final Agreement, the Balanggarra claims (WC00/6 / WAD6004/2000 and WC99/47 / WAD6027/98) are still being resolved.

The Ord River and Parry Lagoons nature reserves are two of four existing reserves to be jointly managed in accordance with the Ord Final Agreement by the department and Yawoorroong Miriuwung Gajerrong

[2] *See: www.slp.wa.gov.au/legislation/agency.nsf/dec_menu.htmlx*

[3] *Any action that is likely to have a significant impact on the ecological character of a Ramsar wetland (whether the action is to occur inside the wetland or not) is required to be assessed under a statutory environmental impact assessment and approval process. This is also the case for other matters of national environment significance under the EPBC Act (i.e. threatened species and ecological communities, and migratory species protected under international agreements).*

Yirrgeb Noong Dawang Aboriginal Corporation, through the Yoorrooyang Dawang Regional Park Council. The other two existing reserves are Mirima National Park and Point Springs Nature Reserve. As specified in the Ord Final Agreement, joint management is dependent on resources being available, including staffing and funding. Before conducting any works on their country within the planning area, and regardless of native title having been resolved over their country, consultation with traditional owners will remain consistent with the Native Title Act. Further to this, a joint management agreement under the CALM Act will need to be prepared, which may require the amendment or review of the management plan.

The department and the Conservation Commission are also interested in pursuing joint management arrangements for the applicable portion of the planning area with the Balanggarra people. During the life of the plan, if joint management is identified as a priority and there are the resources and capacity to undertake it, a joint management agreement under the CALM Act may be considered, which may require the amendment or review of the management plan.

The Ord Final Agreement also resulted in the identification of six areas surrounding Kununurra that will be freehold land held by Miriuwung-Gajerrong Trustees Pty Ltd and leased to the state for joint management by Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation. These areas are to be managed jointly and include the proposed:

- Mijing conservation park
- Jemandi-Wooningim conservation park
- Goomig conservation park
- Barrbem conservation park
- Darram conservation park
- Ngamoowalem conservation park.

Mijing and Ngamoowalem are adjacent to Ord River and Parry Lagoons nature reserves (see Map 2). The *Yoorrooyang Dawang Conservation Parks Management Plan* (final in preparation) will guide joint management under the CALM Act of the proposed conservation parks.

Desired outcome

- Traditional owner involvement in management of the planning area.

Management actions

1. Prepare a joint management agreement under the CALM Act with the Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation, as resources become available, as identified in the Ord Final Agreement.
2. Determine interest of pursuing joint management arrangements for the applicable portion of the planning area with the Balanggarra people.
3. Foster relations with other traditional owners who speak for country.
4. Ensure consultation with and approval from traditional owners who speak for country, for any amendments to land tenure that may occur over land for which they speak.
5. Work with traditional owners to promote their participation in commercial activities.
6. Ensure consultation with and approval from traditional owners who speak for country, for any research activities that may occur on land for which they speak.
7. Refer development and resource use proposals to traditional owners who speak for country.

7. Assessing performance

It is not efficient to measure all aspects of management given resource and technical limitations—consequently, indicators have been chosen to target key components of the plan. The Conservation Commission will measure the success of this plan in accordance with section 19(1)(g)(iii) of the CALM Act by using key performance indicators and other mechanisms as appropriate.

The specific 'limits of acceptable change' (LAC) for the Ord River Floodplain Ramsar site identified by Hale (2008) have been incorporated into this management plan, and corresponding key performance indicators identified.

The department is required to establish and maintain a portfolio of evidence relating to key performance indicators throughout the life of the plan to enable measurement of implementation and management effectiveness of actions. The first step is establishing adequate baseline data.

8. Administration

The day-to-day implementation of the final management plan will be the responsibility of the department's East Kimberley District, which coordinates the operational management of reserves in the planning area.

9. Term of plan

The management plan will guide management of the planning area for a period of 10 years from the date the final management plan is gazetted. During this time, amendments to the final management plan are allowed under section 61 of the CALM Act. If an amendment is necessary, the proposed changes will be released for public comment. At the end of the 10-year period, the management plan may be reviewed and a new management plan prepared. In the event that the plan is not reviewed and replaced by the end of the 10-year period, it will remain as the primary guiding document for the area.

Parry Lagoon. Photo – Laurina Bullen/DEC

Managing the natural environment

10. Physical environment

Climate

The planning area has a semi-arid, monsoonal climate with a prolonged dry season from May to September. Data collected from the Wyndham meteorological site show the average annual rainfall varies across the planning area, from 900 millimetres to 1,200 millimetres. Evaporation rates far exceed rainfall the majority of the year, with an average annual evaporation rate of 2,800 millimetres. Wet season average maximum temperatures vary between 36°C and 40°C and minimum temperatures between 25°C and 27°C. During the dry season average maximum temperatures are slightly cooler, between 31°C and 36°C and minimum temperatures are between 16°C and 22°C (BoM 2009).

Management actions for the planning area, relating to the creation of reserves, management of fire and control of introduced animals and weeds may help improve the resilience of species and ecosystems and thereby decrease their vulnerability to climate change. A landscape approach that links large, contiguous habitats or that enables maintenance of ecological processes, especially those across a range of environmental gradients, will provide the optimal approach for species and ecological processes to respond to changing climatic conditions.

Geology, landforms and soils

The Carpentarian land system comprises the majority of the planning area to the north, characterised by Quaternary alluvia geological material forming the estuarine-deltaic mangrove plains, and an isolated pocket of the Cockatoo land system (Permian, Lower Carboniferous, Upper Devonian and Ordovician-Cambrian geological material of sandstone, calcareous sandstone, calcareous conglomerate and minor limestone). The majority of the southern parts of the planning area are characterised by the Pinkerton and Ivanhoe land systems, interspersed with smaller areas of the Cockburn, Angallari and Frayne land systems. Adelaidean and Carpentarian geological material and Quaternary alluvia form the majority of this area, interspersed with lower Proterozoic and lower Cambrian material (Stewart *et al*. 1970).

Geology and geomorphology influence catchment hydrology by affecting the development of aquifers, seepage points, discharge zones and drainage patterns. The planning area spans across the Cambridge Gulf Lowlands subregion of the Ord-Victoria geomorphic unit and into the Kimberley Plateau geomorphic unit to the south.

The damming of the Ord River is considered to have dramatically changed the sedimentation process with anecdotal evidence indicating that parts of the river have become shallower because of the lack of scouring by floodwaters (Wolanski et al. 2004). Sediment deposition now dominates the entire length of the Ord River and False Mouths of the Ord creating extensive mudflats and dendritic streams, which are important in terms of mangrove communities, invertebrate populations and the waterbirds that feed on them. Broad sandy or gravely spits and bars occur along upstream reaches while unstable mud bars and islands become common toward the mouth.

Hydrology

Hydrological influences are the primary driver of wetland ecology (Mitsch and Gosselink 2000) and are the principal constraint on the distribution and productivity of wetlands (Mendelssohn and Batzer 2006). Inundation is influenced by surface water, groundwater and tidal regime, and is crucial for wetland plant ecology (Hale 2008). In addition, fauna responds to hydrology directly, such as hydrological cues for breeding or migration, and indirectly via vegetation distribution.

The floodplain of the lower Ord River is a complex network of intermittent and occasionally permanent streams. The major sources of freshwater directly into the floodplain are from the Ord River itself, Parry Creek and the major tributaries of the False Mouths of the Ord; Emu, Tanmurra and Station creeks. The planning area lies within the Timor Sea Drainage Division.

Surface water within the region is highly seasonal and supports significant natural, recreational and cultural values as well as drinking water for local communities and use in the expanding agricultural industry. Surface water in the area has been significantly modified from its natural state and is being diverted for use in agriculture and power production (see *Altered hydrological regimes* and *Water resources*).

Parry Lagoons contains seasonally inundated floodplains and permanent or near-permanent water bodies, which are inundated via surface water flow from the Ord River or Parry Creek. Inundation is at its greatest extent and depth during March and April at the end of the wet season. The low relief claypans and marshes are typically less than one metre deep, and dry out by June–July. The deeper waterholes, however, are permanent or near permanent.

Parry Creek is a seasonally flowing creek running through upland environments, and an alluvial floodplain complex. The expansive floodplain provides an array of seasonal and permanent freshwater wetlands that are important feeding and breeding habitat for migratory shorebirds, waterbirds and juvenile fish populations when flooded, and a refuge for resident aquatic flora and fauna during the dry season.

Similarly, the floodplains contain vegetation communities that typically require seasonal inundation, but also dry periods where air can fill soil pore spaces. Without the wet–dry cycles, these vegetation communities, together with the fauna they support, could not exist.

Marlgu Billabong, Parry Lagoons Nature Reserve. Photo – DEC

Groundwater is generally considered to flow from the Carlton and Mantinea flats proposed irrigation areas into the Ord River near the upstream limit of the planning area (O'Boy et al. 2001). During high tides it is possible that the flow of groundwater could be reversed with saline water flowing back under the plains. Groundwater levels fluctuate with seasonal rainfall. The planning area is located within the Canning-Kimberley Groundwater Proclamation Area.

A detailed airborne electromagnetic study (Apps et al. 2011) was conducted in the Ord Irrigation Area and included parts of Parry Lagoons Nature Reserve. This study provides spatial information on salinity and groundwater.

The tidal regime is important for maintaining several habitats and vegetation communities within the system. The variation in inundation of the banks of the dendritic creeks of Ord River Nature Reserve provides for a range of habitats for different mangrove species and results in a distinct zonation. Tidal cycles may also provide cues for invertebrate breeding, such as banana prawns (*Fenneropenaeus merguiensis*), and influence productivity. These macro-tides are important for maintaining nutrient cycling processes within the planning area by facilitating the export of nutrients from the catchment to the Indian Ocean.

Tidal variation also influences salinity levels upstream and increasing saline groundwater intrusion maybe impacting on vegetation in the planning area.

Activities within the catchment such as agriculture and mining can affect water quality within the planning area. Water quality (both physical and chemical properties for example, salinity, suspended solids, dissolved oxygen, nutrients and non-nutrient contaminants) within the planning area and the wider Ramsar site will need to be monitored (see *Research*). Several limits of acceptable change have been identified in the *Ecological character description of the Ord River Floodplain Ramsar site* to trigger when action is required (if already not underway) to conserve the ecological character of the Ramsar site. Where limits of acceptable change do not exist, the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZECC 2000a) trigger values may be used as a guide.

Desired outcome

- Maintain hydrological regimes occurring at the time of Ramsar listing in 1990.

Management actions

1. Liaise with the Department of Water (DoW) to provide input into environmental water allocations for the Ord River.
2. Undertake studies to increase knowledge of hydrological requirements of the Ord River to maintain ecological values.
3. Work cooperatively with state and federal government authorities to maintain Ramsar values.

11. Biological environment

Native plants and plant communities

The planning area supports a diverse assemblage of native plants and their communities. More than 300 terrestrial and wetland dependent species of plants have been recorded, including three priority 1 species (*Echinochloa kimberleyensis, Goodenia brachypoda* and *Utricularia stellaris*), two priority 2 (*Nymphaea immutabilis* and *Utricularia aurea*) and three priority 3 (*Brachychiton incanus, Paspalidium distans* and *Psilotum nudum*) flora species. A wide variety of plant communities have been identified, including mangrove and saltmarsh, wetland grasslands and sedges, riparian woodland, and aquatic vegetation (Hale 2008).

Yellow kapok (*Cochlospermum fraseri*). Photo – Melissa Mazzella/DEC

A flora species list for the Ramsar site can be found in the *Ecological character description of the Ord River Floodplain Ramsar site* (Hale 2008) and for the planning area on the department's *NatureMap* database (http://naturemap.dec.wa.gov.au).

Mangrove and saltmarsh

The planning area contains 16 of the 18 species of mangrove found in WA (Johnstone 1990; Semeniuk and Semeniuk 2000). Five species of halophytic saltmarsh have been described in association with the mangrove communities. These include: *Tecticornia* spp., *Batis argillicola*, *Salsola tragus*, *Sesuvium portulacastrum, Sporobolus virginicus* and *Suaeda* sp. (Thom et al. 1975). An exceptional example of mangrove community has been surveyed on Adolphus Island that meets the classification threshold of the Australian Heritage Commission (Pedretti and Paling 2001). This management plan recommends Adolphus Island be incorporated into the planning area to provide protection to the mangal community (see *Management plan area*).

Wetland grasslands and sedges

The floodplain of Parry Lagoons Nature Reserve is dominated by grassland communities, characterised by annual grasses Australian wild rice (*Oryza australiense*) and beetle grass (*Diplachne parviflora*). The annual wetland shrubs sesbania pea (*Sesbania cannabina*) and budda pea (*Aeschynomene indica*) can form extensive tall thickets across the floodplain following periods of major inundation. Some of the most frequently inundated southern basins support dense beds of sedge dominated by *Eleocharis brassii* (CALM 1998).

Riparian woodland

The floodplain of Parry Lagoons Nature Reserve contains extensive woodland communities that are periodically inundated by floodwaters. Common canopy species include river red gum (*Eucalyptus camaldulensis*), northern salmon gum (*E. bigalerita*), Darwin box (*E. tectifica*) and guttapercha tree (*Excoecaria parvifolia*).

Aquatic vegetation

The permanent wetlands within the Ramsar site contain a diverse aquatic flora community that provide habitat and forage for a range of waterbirds during the wet and dry seasons.

Inundation directly affects the plant communities associated with Parry Lagoons Nature Reserve. True freshwater aquatic plants are generally confined to the permanent waterholes within Parry Lagoons. These species are adapted to permanent inundation with mechanisms for coping with anaerobic soils and are reliant on the presence of surface water for survival.

Water lilies at Marlgu Billabong. Photo – Laurina Bullen/DEC

Desired outcome

- Conserve native plants and plant communities.

Management actions

1. Maintain and monitor vegetation diversity by reducing threatening processes, such as inappropriate fire regimes, altered hydrological regimes and high densities of introduced animals, such as cattle.
2. Work cooperatively with state and federal government authorities to maintain Ramsar values.

Key performance indicator

Performance measure	Target	Reporting requirement
Methodology to measure condition and composition of vegetation	Subject to natural variations, no deterioration in the condition and composition of vegetation	Five yearly

Native animals and habitats

The planning area supports critical life stages of annual migration for bird species and provides seasonal drought refuge for a variety of bird species. There are records of 105 waterbird species, 16 wetland-dependent bird species, 21 mangal restricted forest bird species, 37 mammals, 17 bats, 87 aquatic invertebrates and more than 50 species of fish. Two new conservation areas, Mijing and Ngamoowalem, are located adjacent to the planning area and provide contiguous, protected habitat for native animals and therefore provide for improved cross-boundary management.

Many fauna species of conservation significance are found within the planning area and local vicinity, including species specially protected as threatened fauna under the Wildlife Conservation Act. Notable species of conservation significance include:

- three threatened species with a rank of endangered – Gouldian finch (*Erythrura gouldiae*), crested shrike-tit (*Falcunculus frontatus whitei*) and northern quoll[4] (*Dasyurus hallucatus*)
- three threatened species with a rank of vulnerable – flatback turtle, Australian painted snipe (*Rostratula benghalensis australis*) and red goshawk (*Erythrotriorchus radiatus*)
- four priority species – flock bronzewing (*Phaps histrionica*), bush stonecurlew (*Burhinus grallarius*), eastern curlew (*Numenius madagascariensis*) and water rat or rakali (*Hydromys chrysogaster*)
- two species that are otherwise specially protected under section 14(2)(ba) of the Wildlife Conservation Act – saltwater crocodile and freshwater crocodile (*Crocodylus johnstoni*)
- 32 migratory waterbird species listed under international agreements
- 19 marine bird species listed under the EPBC Act.

[4] *A national recovery plan exists for the northern quoll (www.dec.wa.gov.au/pdf/plants_animals/threatened_species/frps/nth_quoll_rp-adopted_261110.pdf).*

The number of waterbirds recorded breeding is assumed to be incomplete, given the limited extent of published bird records. The planning area includes extensive and diverse nesting habitats, ranging from wooded swamps to open marshes with plenty of dense cover. In addition access is extremely difficult during the wet season, the time when habitat and food resources are most available to waterbird species. It is likely that this species list and the abundance values will change with increased survey efforts and monitoring.

The planning area provides important nursery, breeding and feeding sites for fish, with environments ranging from freshwater, to estuarine and marine. This allows for feeding and breeding migration between all three habitats. It is predicted that the area could support more than 50 species of fish; however, fish populations have received little research attention.

Valuable crocodile breeding habitat is found east of Ord River Nature Reserve. A 40-metre-wide strip of unallocated Crown land (UCL) is located adjacent to the inland side of the Ord River Nature Reserve boundary from the high water mark to 40 metres above it. Extending the boundary of the nature reserve to be 40 metres above the high water mark will incorporate this area of UCL into the reserve and provide additional protection for crocodile breeding areas.

Crocodiles are found in the planning area. Photo – DEC

Adolphus Island was surveyed in 2008 and 2009 as part of the *Kimberley Islands Biological Survey*. Northern quolls (*Dasyurus hallucatus*) were trapped at two Adolphus Island survey sites (T Handasyde pers. comm.). The only other confirmed records of northern quolls in the east Kimberley are a 1908 WA Museum specimen from the planning area and a recent sighting (confirmed by a photograph by T Sinclair) from neighbouring El Questro Station. The proposed addition of Adolphus Island to the planning area will provide protection for the island population of northern quolls in the short term, although cane toads will pose a potential threat to their continued survival.

Flatback turtle (*Natator depressus*). Photo – DEC

A large flatback turtle rookery is located at Cape Domett. Although limited research has been conducted on the species in this area, this is thought to be among the largest of all known flatback nesting populations, with an estimated yearly population in the order of several thousand turtles (Whiting et al. 2008). As this species is protected under the Wildlife Conservation Act, it is recommended that Cape Domett be incorporated into the Ord River Nature Reserve. Fauna species lists for the Ramsar site can be found in the *Ecological character description of the Ord River Floodplain Ramsar site* (Hale 2008) and for the planning area on the department's *NatureMap* database (http://naturemap.dec.wa.gov.au).

Desired outcome

- Conserve specially protected and other native fauna.

Management actions

1. Support the preparation and implementation of recovery plans for any threatened fauna species.
2. Protect native fauna from introduced and problem animals through appropriate control regimes where necessary.
3. Work cooperatively with state and federal government authorities to maintain Ramsar values.
4. Monitor the abundance and composition of key fauna species.

Key performance indicator

Performance measure	Target	Reporting requirement
Abundance and composition of birds, crocodiles and turtles[5]	Subject to natural variations, no reduction of the abundance and composition of birds, crocodiles and turtles	Five yearly

12. Protection of the natural environment

Environmental weeds[6]

Weeds displace native plants, particularly on disturbed sites, by competing with them for light, nutrients and water. Other impacts include the prevention of native seedling recruitment, changes to soil nutrients, and changes to the abundance of native fauna. They can also have a significant adverse impact on other conservation values by altering animal habitats, harbouring pests and diseases, and changing fire regimes by increasing fire hazard.

As part of a wider regional study, the *Kimberley Weed Project* was undertaken by the department. It provides tools for a coordinated national approach to the assessment, management and prevention of new weed incursions (see the department's FloraBase database http://florabase.dec.wa.gov.au). Further to this, the department has undertaken an *Invasive Plant Prioritisation Process*, an integrated approach to weed management in WA and a progression of the *Environmental Weed Strategy for Western Australia* (CALM 1999a). This process provides a ranking of threat of weed species on a statewide basis against specific criteria, and aims to consider both a 'species-led'; and a 'site-led' or 'asset-based approach' to control the threat of environmental weeds within WA. Information on the process and assessment for the department's Kimberley Region can be found on the department's website.

Key weeds including parkinsonia (*Parkinsonia aculeata*), a Weed of National Significance, noogoora burr (*Xanthium occidentale*) and bellyache bush (*Jatropha gossypiifolia*), Weeds of Potential National Significance, persist within Parry Lagoons Nature Reserve. However, management efforts by the department to date have controlled the spread of weeds. The Department of Agriculture and Food maintains a noogoora burr quarantine zone within the planning area. Other weeds that are found upstream of the planning area, and thereby pose a threat to the planning area, include rubber vine (*Cryptostegia grandiflora* and *C. madagascariensis*) and *Mimosa pigra*, all Weeds of National Significance. With the development of horticultural crops in Ord Stage 2, the potential for invasion by *Moringa oleifera* and other crop species could increase.

[5] Turtles to be assessed as part of the key performance indicator once Cape Domett tenure becomes a nature reserve.
[6] Environmental weeds are plants that establish themselves in natural ecosystems and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade (CALM 1999a).

Desired outcome

- Prevent loss of native species and decline in plant communities from weed invasion.

Management actions

1. Consistent with regional weed prioritisation, prepare, implement and monitor a weed control program based upon invasiveness, existing and potential impacts, current and potential distribution, and feasibility of control.
2. Support the Australian Quarantine and Inspection Service to monitor the occurrence of, and potentially control the spread of, weed species.
3. Continue to work with other agencies and adjacent landholders to control environmental weeds.

Key performance indicator

Performance measure	Target	Reporting requirement
Location and extent of high priority weed species	A reduction in the location and extent of high priority weed species	five yearly

Introduced and other problem animals

Problem animals are those species that have the potential to cause serious impact on natural systems through direct effects such as predation, habitat destruction, competition for food and territory, and introduction of disease, and through environmental degradation, such as overgrazing. Problem animals can be either native species that are impacting on natural or agricultural values, or introduced species that have become established as wild or naturalised populations. The most significant introduced species within the planning area is cattle (*Bos taurus*). Cane toads (*Bufo marinus*) reached the planning area in May 2011 (DEC 2011). Little is known of the impact from feral honey bees, cats and feral pigs; however, the potential for invasion remains. The Judas Donkey Program, run by the Department of Agriculture and Food and partially funded by DEC, has successfully eradicated donkey populations in the local area.

Cattle (*Bos taurus*). Photo – DEC

Cane toad (*Bufo marinus*). Photo – DEC

Desired outcome

- Prevent impacts of introduced and other problem animals on the values of the planning area.

Management actions

1. Consistent with regional prioritisation for introduced and problem animals, prepare a control program based upon existing and potential impacts, current and potential distribution, feasibility of control and capacity for long-term monitoring.
2. Work with neighbours to limit cattle intrusions onto the reserves (for example, assist adjoining landowners to ensure boundary fences are adequate to exclude cattle, where practicable).
3. Support the Australian Quarantine and Inspection Service and Department of Agriculture and Food to monitor the occurrence of, and potentially control the spread of, introduced animals.
4. Implementation of the State Cane Toad Initiative, in collaboration with community-based groups and scientific institutions, to slow the westward spread of cane toads.

Altered hydrological regimes

The hydrological regime in the planning area is significantly altered from its natural state. The Ord River is dammed at two points upstream of the planning area. The Kununurra Diversion Dam was constructed in 1963 and Argyle Dam constructed in 1973 to enable water regulation and development for the Ord River Irrigation Area (ORIA) Stage 1. Further hydrological alteration occurred with the lifting of the Argyle Dam wall in 1995 for hydropower generation. These dams markedly altered flood frequency and extent and sediment deposition characteristics. The Argyle Dam is highly effective at constraining wet season flood peaks and trapping sediment loads from the majority of the catchment. Once a river with only seasonal flow, the Ord River flow is now perennial because of constant discharge from the Kununurra Diversion Dam, and, as such, flood events are less frequent and occur for shorter periods.

Since the construction of the Argyle Dam, the wet season flood peaks and sediment pulses in the lower Ord River are almost certainly determined more by flooding from the Dunham River and sediment being deposited downstream from the Dunham River and upstream from the Cambridge Gulf. It is likely that the alignment of the main stream channel of the lower Ord River is more stable than in the past, though shallower and wider.

Hydrological modelling of the Ord River was performed pre- and post-dam construction. Before dam construction, at a 10 per cent annual exceedence probability, numerous flood breakouts occurred from the main Ord River channel, including flooding of a significant portion of the Parry Lagoons and Mantinea Flats areas. Flooding at this time was strongly influenced by river flows (Rodgers and Ruprecht 2000).

After dam construction, at a 10 per cent annual exceedence probability, major flooding at Mantinea Flats is significantly reduced and only a small to moderate area near Parry Lagoons experiences flooding. Therefore, as a result of the dam construction combined with reduction in intense rainfall events, flooding at Parry Lagoons is now more strongly influenced by the combination of tidal regimes and regulated river flows (Rodgers and Ruprecht 2000).

The *Ord River Water Management Plan* (DoW 2006) has set environmental flow conditions for water discharge from Lake Kununurra Diversion Dam to maintain the current environmental condition of the Ord River. It is unclear if these flow conditions reflect the flow of the Ord River, and therefore the ecological character, between the time of Ramsar listing in 1990 and raising of the Argyle Dam wall in 1995 (see Appendix 1). Flows may need to be altered to ensure adequate environmental flow is achieved to maintain the ecological character of the Ramsar site. DoW is responsible for environmental flow allocation and monitoring as described in *Lower Ord River environmental water provisions monitoring program and management framework* (DoW 2011).

Mouth of the Ord River. Photo – DEC

Development of ORIA Stage 2 is estimated to have a relatively small effect on the modelled flood flows experienced by the Ord River, particularly in comparison to the changes to modelled flood flows as a result of the construction of the two dams (Rodgers and Ruprecht 2000).

Projects that permanently modify water movement within the Ord River, such as tidal power, would pose a significant threat to the key values of the planning area. Any such proposal would need to be considered for assessment under the EP Act and EPBC Act. Potential issues with such proposals may include:

- loss of connectivity between the Ord River and the Cambridge Gulf estuary impacting aquatic animals including saltwater crocodiles, diadromous fish, reptiles, crustaceans and benthic dwellers
- significant changes to the hydrological regime influencing salinity concentrations, sediment dynamics and nutrient cycling of the Ord River
- flooding of parts of Ord River Nature Reserve and along upstream banks of the Ord River causing death of and/or stress of mangrove and other vegetation and loss of, or alteration to, saltwater crocodile habitats
- inconsistency with the purpose of a nature reserve.

Desired outcome

- Prevent impacts of altered hydrological regimes on the values of the planning area.

Management actions

1. Work with DoW and Water Corporation to provide information to assess adequate flow for the Ord River to maintain the ecological character of the Ramsar site.

Disease

No plant or animal diseases have been located within the planning area. The Australian Quarantine and Inspection Service monitors migratory birds within the planning area to detect any occurrence of avian bird flu.

Fire

Fire management is a major issue in the region. Values at risk include:

- the lives of visitors to the planning area
- people involved in fire management activities
- native flora and fauna communities
- adjoining lands and assets (including cultural assets).

The occurrence of large, end-of-dry-season fires has led to changes in the structure and composition of vegetation communities and the distribution and abundance of fauna species, such as the decline in population numbers experienced by the Gouldian finch.

The department's prescribed burning program focuses on early dry season burning and the creation of mosaics. Prescribed burning is primarily undertaken along the Great Northern Highway adjacent to the western boundary of Parry Lagoons Nature Reserve to reduce the risk of indiscriminate lighting along the highway. The use of incendiaries dropped from the air and hand burning will continue.

The preparation and implementation of a prescribed burning program is required for the planning area. The program is based on key principles that aim to decrease the trend in late season bushfires and apply landscape mosaic to maintain temporal and spatial distribution of vegetation ages. The planning process is endorsed collaboratively with the Miriuwung Gajerrong traditional owners. The Miriuwung Gajerrong rangers are also involved with the implementation of the prescribed burn program.

Pre- and post-suppression work within the planning area is the responsibility of the department and would include rehabilitation of any fire lines that are constructed as part of suppression efforts.

Desired outcomes

- Protect biodiversity, people and property within the planning area.
- Maintain cultural responsibilities.

Management actions

1. Prepare and implement a prescribed burning program which is in accordance with the key principles and considers the knowledge and responsibilities of traditional owners.
2. Continue to liaise with neighbouring landholders and local government to integrate fire management across the landscape.
3. Integrate fire management with weed and introduced species control programs.

Key performance indicators

Performance measure	Target	Reporting requirement
Loss of life or property from fire	No loss of life or property from fire	Five yearly
Biodiversity	No reduction in biodiversity from fire	Five yearly

Managing our cultural heritage

13. Aboriginal culture and heritage

The conservation of Aboriginal heritage is important in maintaining the identity, health and well being of Aboriginal people. In WA, the *Aboriginal Heritage Act 1972* (Aboriginal Heritage Act) protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act; however, all sites are protected regardless of whether they have been entered on the register.

Aboriginal heritage within the planning area is diverse, consisting of numerous rock art sites, burial sites and mythological sites, including the Ord River. Management must ensure that Aboriginal sites are protected from damage, and that obligations are fulfilled according to the Aboriginal Heritage Act before any planning or public works occur.

The *Miriuwung-Gajerrong Cultural Planning Framework* (Hill et al. 2008) was developed to explain Miriuwung-Gajerrong peoples' approach to looking after country under the Ord Final Agreement. Where relevant, this will be applied to management of the planning area.

The Conservation Commission and the department acknowledge the aspirations of Aboriginal people to obtain native title over their traditional lands and waters under the Native Title Act. The Kimberley Land Council is the native title representative body appointed under Native Title Act for the planning area. Under the *Western Australia v Ward* (2002) 191 ALR 1 (8 August 2002) (the Ward decision) native title over Parry Lagoons Nature Reserve was held to be extinguished, not withstanding this, the department will continue to consult with traditional owners before major public works are undertaken. The department will continue to recognise the interests of Aboriginal people and their desire to continue cultural activities and customs in the planning area.

Irrespective of whether native title has been determined, Aboriginal people may still have the right of access for sustenance, maintenance and protection of important places and paintings, and the inheritance of native title rights. Activities that can be undertaken include free movement, fishing, ceremonies, visiting and protecting important places. Amendments to the CALM Act and Wildlife Conservation Act (once proclaimed) will build on existing customary activity entitlements and are in recognition of Aboriginal people's intrinsic connection to the land.

Desired outcomes

- Protect and conserve the value of the land to the culture and heritage of Aboriginal persons.
- Traditional owners using their traditional lands for customary purposes.

Management actions

1. Enhance understanding of the value of the planning area to the culture and heritage of Aboriginal persons.
2. Ensure that the values of the land to the culture and heritage of Aboriginal persons inform and guide management actions.
3. Where applicable, apply the *Miriuwung-Gajerrong Cultural Planning Framework* (Hill et al. 2008) to inform and guide management actions.
4. Work with traditional owners who speak for country, to protect heritage sites within the planning area.
5. Ensure management activities attempt to minimise material adverse effect on Aboriginal culture and heritage.

Key performance indicator

Performance measure	Target	Reporting requirement
Material adverse effects of Aboriginal cultural heritage sites	No material adverse effects to Aboriginal cultural heritage sites because of management activities	Five yearly

14. Other cultural heritage

The graziers of the East Kimberley were preceded by early exploration of the area by Alexander Forrest in 1897 and the privately funded expeditions of Patsy Durack in 1882 and WJ O'Donnell in 1883. Parry Creek was named after E Parry, a syndicate member of the Cambridge Downs Pastoral company, which financed O'Donnell's exploration of the area. The lagoons subsequently took their name from Parry Creek, which feed into them (CALM 1999b).

There is also European and Chinese heritage within the planning area. The following structures found within the planning area are listed on the Shire of Wyndham-East Kimberley *Municipal Heritage Inventory* (1997):

- Chinese Gardens Parry Creek – the Chinese Gardens at Parry Creek are tangible evidence of the early Chinese impact on early settlement in the Wyndham locality. They provided fresh fruit and vegetables to Wyndham and the goldfields in Halls Greek from 1889 to 1890.
- Old Telegraph Station – much of the foundations of the old telegraph station are still evident. This was built in 1914 inland from Wyndham because Bastion Hill blocked reception. It was used for intelligence communications during the First World War and played a crucial part in the sinking of the German raider *Emden*. Used later to communicate with merchant ships for safety, the station was decommissioned in 1924.
- Curtin's Cowboys – a series of camps near Parry Lagoons used by the 550 volunteers of the North Australian Observer Unit, otherwise known as the Knackeroos. They were formed in response to the Japanese raids in the north of Australia and disbanded in 1945.

Telegraph Hill. Photo – Melissa Mazzella/DEC

Several other features within the planning area were identified as holding heritage significance (Nayton 1998), in particular the cobblestone remnants of Old Halls Creek Road. The department will work collaboratively with the shire to ensure the *Municipal Heritage Inventory* is updated to include all sites of significance within the planning area.

Desired outcome

- Protect other cultural heritage.

Management actions

1. Ensure management activities attempt to minimise material adverse effects on other cultural heritage.

Key performance indicator

Performance measure	Target	Reporting requirement
Material adverse effects on other cultural heritage sites	No material adverse effects to cultural heritage sites because of management activities	Five yearly

Telegraph Hill. Photo – Melissa Mazzella/DEC

Managing visitor use

15. Visitor opportunities and planning

The Kimberley is known locally and internationally for its rugged beauty and remoteness, attracting increasing numbers of visitors each year. The planning area has the potential to offer visitors remote day use and four-wheel-driving experiences.

Visitor planning

Planning for visitor use is required to manage issues of environmental impacts, visitor risk, social benefit, equity, public demand and potential economic benefit. Recreational activities will continue to be generally low key within the planning area.

The provision of consistent and accurate information by internal and external providers is important in protecting values of the planning area and achieving effective communication. The department provides a variety of information on the planning area (for example, about facilities, activities and access) through a variety of means (for example, signage, printed materials, website and staff). Telegraph Hill and the bird hide at Marlgu Billabong are the main interpretive sites in the planning area (see *Information, education and interpretation*).

Possible future developments include:

- stopping points and lookouts at significant natural features or cultural and historical sites along four-wheel-drive routes
- commercial tourism operations
- short walk trails from roadside lay-bys to provide access to features and views over the surrounding landscape.

Low-impact activities and those that facilitate enjoyment, appreciation and understanding of the natural and cultural values will be encouraged within the planning area.

Desired outcome

- Facilitate visitor enjoyment, appreciation and understanding of the values of the planning area.

Management actions

1. Provide a range of opportunities for visitors, and ensure they are consistent with the purpose of the reserves, pose no adverse impacts on the environment or unreasonably interfere with visitor experiences.

Visitor safety

In addition to a genuine concern for visitor welfare, the department has a legal responsibility to consider the personal safety of visitors to the planning area. Factors that contribute to visitor risk in the planning area include:

- facility maintenance
- climate (for example, dehydration and sun exposure)
- hazardous terrain (for example, slipping and tripping on uneven ground)
- remoteness (for example, sites that are hard to access by emergency services and often lacking digital mobile phone network coverage)

- bushfire
- cyclones
- dangerous wildlife (for example, snakes and crocodiles).

Many of these risks are addressed through attention to personal safety, appropriate maintenance of facilities by department staff, and appropriate risk warnings through brochures, promotional material and signage. Risk assessments involve the identification of hazards, assessment of the risks posed by these hazards, implementation of risk mitigation measures and ongoing monitoring. All designated recreation sites are routinely audited to identify visitor risks.

The wetlands of the planning area increase the potential for visitors to be exposed to mosquitoes that have a high possibility of carrying Ross River virus. As mosquitoes are an essential part of the reserve's ecosystem[7] and mosquito control has the potential to jeopardise natural values, the department will not take measures to reduce mosquito numbers. Instead, increasing visitor awareness may help reduce the incidence of infection.

In the event of an incident, the coordination of search, rescue or recovery operations is the responsibility of the WA Police, with the department providing support as requested. However, where these occur on lands managed by the department, and in an area as remote as the planning area, it is often the department that organises the initial response.

Desired outcome

- Minimal risks to visitors and encouragement of appropriate visitor behaviour.

Management actions

1. Develop a visitor risk management plan in accordance with department policy that identifies and assesses the risks associated with all recreation sites and monitors and regularly reviews visitor risk.

Information, education and interpretation

The planning area provides a valuable opportunity for improving community awareness about wetland ecosystems and the values of Ramsar wetlands. An effective information, education and interpretation program is vital to achieving the vision and objectives of maintaining, enhancing and communicating the values of the planning area.

Interpretive signage along the boardwalk at Marlgu Billabong. Photo – Melissa Mazzella/DEC

Interpretation facilities are only located within Parry Lagoons Nature Reserve and are limited to Telegraph Hill, Marlgu Billabong and information bays at access points. Signage at Telegraph Hill explains the history of the area and a walking trail provides botanical and historical details. Information bays depict life in the area for early settlers and Aboriginal people and detail any projects underway in the reserve. Given the importance of Marlgu Billabong as waterbird habitat, the bird hide and boardwalk are popular with visitors. It is a high priority to upgrade the signs and information for the purpose of public education and interpretation to assist in achieving conservation objectives.

[7] *Mosquitoes provide an importance source of food for their predators forming a key component of the ecological food chain.*

Programs and activities aimed at increasing public education on the values of the planning area will be supported by the department.

Several publications and brochures on the area are available. It is a high priority to review and edit the information they contain before being reprinted.

The department's website also provides an important means of distributing information on the significant values of the planning area.

Desired outcome

- Increase community awareness, understanding and appreciation of the values of the planning area to foster support for its protection and effective management.

Management actions

1. Provide information to visitors, volunteers, commercial operators and the tourism industry on:
    - day-use opportunities
    - the values and management issues within the planning area such as its importance for migratory waterbirds, visitor safety, permitted activities and regulations
    - cultural heritage to promote visitor awareness, appreciation and understanding
    - potentially hazardous areas and activities
    - Leave No Trace principles.[8]
2. Update existing signage and brochures and install new signs at all access points, including information on Aboriginal cultural interpretation.
3. Increase community awareness of the need to keep domestic animals out of the planning area.

16. Visitor access

Access within the planning area is provided to allow passive recreational use, as well as for management and emergency vehicles. All roads within the planning area are only adequate for four-wheel-drive vehicles and are impassable during the wet season.

Vehicle access to Parry Lagoons Nature Reserve is via Parry Creek Road, accessed either from the Great Northern Highway in the west or Old Wyndham Road in the east and maintained by the Shire of Wyndham-East Kimberley. The shire is also legally responsible for Parry Creek Road.

There is no formal vehicle access to Ord River Nature Reserve on the east of the Ord River, as the reserve is bound by Carlton Hill Pastoral Station. Visitation to the area is minimal, and is often via boat from Wyndham to the Cambridge Gulf and False Mouths of the Ord.

It is proposed that no new vehicle access tracks are created by the department for the purpose of public access or management access in the planning area throughout the life of this plan. Informal roads or tracks may be closed to the public as necessary, by using signage or natural barriers, because of the risk of degradation of natural and cultural values and issues of visitor safety.

Desired outcome

- Provide safe and convenient access within the planning area for visitors and management, where appropriate.

[8] *See www.lnt.org.au/*

Management actions

1. Maintain designated access points to the planning area to facilitate four-wheel-drive, walking and birdwatching activities.
2. Pending a future increase in visitor numbers, develop defined walking trails if required.

17. Visitor activities and use

Recreational activities that take place within the planning area include birdwatching, scenic and wildlife photography, picnicking, fishing, boating, and four-wheel driving.

Traffic counters are not used within the planning area and visitor numbers are not recorded. This management plan recommends traffic counters are installed at Marlgu Billabong to provide data on the level of visitation. This will assist in determining future recreational requirements within the planning area.

Day use

Birdwatching and nature appreciation

Birdwatching is a popular activity within the planning area, particularly at Marlgu Billabong. The Ord River contains a variety of habitats for birds, ranging from deep water popular with diving species such as cormorants, darters and pelicans, to shallow areas that attract waders and shorebird species. Mangrove and saltmarsh habitats, wetland grasslands and sedges, riparian woodlands and aquatic vegetation are all represented. The planning area has large populations of seasonal waterbirds, some of which are threatened.

A bird hide, boardwalk, signs and interpretation panels are located within Parry Lagoons Nature Reserve. Picnicking is common at Crocodile Hole and Marlgu Billabong; however, the locations are informal and the department does not provide facilities.

Bird hide at Marlgu Billabong. Photo – Melissa Mazzella/DEC

Fishing

Fishing activities are primarily managed by the Department of Fisheries under the *Fish Resources Management Act 1994*, which sets out seasons, size and bag limits. In freshwater areas species targeted include barramundi (*Lates calcarifer*) and sooty grunter (*Hephaestus fuliginasus*). In saltwater and tidal areas species targeted include threadfin salmon (*Eleutheronema tetradactyum* and other *Polydactylus* spp.), cod (*Serranidae* spp.), barramundi and mulloway (*Protonibea diacanthus*). Crabbing for mud crabs (*Scylla* spp.) is known to occur; however, the extent is not known.

Boating

Boating is a popular activity in the area, mainly in motorised boats and generally in conjunction with fishing pursuits. There are no boat ramps within the planning area, with access generally from the boat ramp at Wyndham town site. An informal boat launch site is located at Tanmurra Creek within the False Mouths of the Ord, which is accessed through Carlton Hill Station.

Motorised boating is not permitted in the lagoons within Parry Lagoons Nature Reserve to prevent disturbance to birdlife, and for safety purposes due to the presence of crocodiles. It is recognised that it may be necessary for motorised boats to operate on the lagoons in some circumstances, such as during search and rescue operations, scientific research and for inspections by government agencies. In these instances approval of the department's regional manager is required.

Overnight stays

Formal designated sites for overnight stays and camping are not provided for within the planning area. Visitors wanting to stay within the general area are able to make use of accommodation facilities at Parry Creek Farm, a freehold property within the planning area. Other facilities are located within Wyndham, 50 kilometres north-west, and Kununurra, 100 kilometres east of the planning area along the Great Northern Highway.

Informal camping is known to occur at Tanmurra Creek within Ord River Nature Reserve. The location of the camp site is close to mangroves, and often infested with sand flies. The department does not provide facilities such as toilets or rubbish removal at Tanmurra Creek. As such, visitors are encouraged adopt the Leave No Trace principles. These provide visitors with a number of pre-trip safety guidelines, as well as with guidelines applicable during the trip, including rubbish disposal, toilet waste disposal and keeping to existing tracks.

Alternative opportunities for camping may be investigated over the life of the plan.

Desired outcome

- Passive, low impact visitor use of the planning area.

Management actions

1. Encourage visitor use that is consistent with protecting and promoting the values of the planning area.
2. Provide a range of day-use opportunities consistent with department policies as resources permit.
3. Provide management solutions to mitigate visitor impacts.

Domestic animals

Domestic animals are not permitted within nature reserves as it is inconsistent with the tenure nature reserve.

Commercial operations and tourism

Leases are formal agreements that allow exclusive use of land as a means of providing security to protect significant investments. Currently, there are no recreation or tourism leases in the planning area. Leases on DEC-managed land are assessed against a range of sustainability indicators including design, environmental, cultural and social impacts, safety and risk management, interpretation and education, customer service, marketing, and contribution to management.

Licences allow private tour operators conducting commercial tourist activities to access and use DEC -managed lands. They also enable the department to monitor and regulate access and use to ensure the values of the planning area are maintained. Commercial tour operators interact with visitors on a regular basis and play a significant role in disseminating information. There are currently more than 65 'T' class commercial operators licensed to conduct tours in Parry Lagoons Nature Reserve, the majority being four-wheel-drive or safari operations offering bushwalking along with other activities including birdwatching. No tour operators currently hold licences for Ord River Nature Reserve.

The highly attractive visual amenity of the planning area is popular for filming ventures. Organisations and individuals planning to undertake commercial filming must obtain a permit from the department before filming.

Desired outcome

- Commercial tourism activities that extend the range of services, facilities and experiences available, which are compatible with management outcomes.

Management actions

1. Evaluate proposals for licences and commercial tourism leases according to legislation and departmental policies and allow their establishment where appropriate.
2. Ensure that all commercial operations are managed under a lease, licence or permit agreement with appropriate conditions.

Parry Lagoons Nature Reserve. Photo – Melissa Mazzella/DEC

Managing resource use

Resource use refers to consuming natural resources to provide economic and social benefit. This usually requires the determination of sustainable yield or allocation limits to ensure the natural resources are not consumed beyond acceptable means (WA Government 2007). Using the natural resources of the planning area in a sustainable manner is critical to the long-term management, conservation and protection of such resources.

18. Mineral and petroleum exploration and development

The Department of Mines and Petroleum (DMP) administers the *Mining Act 1978* (Mining Act) and is responsible for the granting of various tenements including prospecting licences, exploration licences, general purpose leases and mining leases for the exploration and subsequent development of minerals in WA. The latest information on mining tenements in the planning area can be found on DMP's Tengraph database.

Extraction of basic raw materials from the planning area by local government authorities for use on road reserve enclaves within the planning area occurs under the *Local Government Act 1995* and with departmental approval. Extraction by private contractors or individuals for use on private easements within DEC-managed land occurs under the Mining Act. It is preferred that basic raw materials for road construction and recreation developments are obtained from outside the planning area, or from areas that are already disturbed or of lower conservation value. To prevent the unwanted introduction of weeds and disease into the reserves, quarantine/hygiene measures are required.

Desired outcome

- Minimal impacts from mineral and petroleum exploration and development, including basic raw material extraction and development activities, on the values of the planning area.

Management actions

1. Refer proposals, where appropriate, to the Conservation Commission, to provide advice to the Minister for Environment.
2. Ensure access to basic raw materials from within the planning area by local government authorities and private contractors is allowed only when:
    - the material is to be used within the planning area
    - extraction complies with this management plan and the purpose, class and tenure of the reserves
    - extraction complies with existing department policies and guidelines.

19. Water resources

Water abstraction and extraction is regulated under the *Rights in Water and Irrigation Act 1914* (RIWI Act) that is administered by DoW, the agency responsible for the protection and management of water resources. Under the RIWI Act, proponents are required to obtain a licence from DoW to extract water from the Canning Kimberley Groundwater Proclamation Area and the Ord Irrigation District that crosses over the planning area and surface water management area adjacent to the planning area. Proponents seeking to extract water from within the boundary of the planning area are also required to obtain a permit under the CALM Act. Where infrastructure for water extraction is necessary, a lease may also be required.

Surface water diversion by the dams along the Ord River provides or allows for uses such as commercial water needs for irrigation and hydropower generation. Demand for water in the area is growing due to expansions of these projects. The *Ord River Water Management Plan* (DoW 2006, under review) establishes how water from the Ord River should be shared between the competing needs of the environment, current and future irrigation and hydropower generation.

There is no extraction of surface water from the lower reaches of the Ord River adjacent to the planning area. The tidal influence on the Ord River causes saltwater intrusion which would result in an unsatisfactory taste of the water. If there is a future need to source water from the Ord River, all infrastructure should be located within Parry Creek Road Reserve.

Mantinea Flats, on the eastern boundary of Parry Lagoons Nature Reserve south of the Ord River, has been identified for horticultural development during the implementation of ORIA Stage 2 (see Map 2). Potential issues involved with the design and management of Stage 1 and further development of Stage 2 include:

- direct and indirect impacts on Parry Lagoons Nature Reserve. Portions of the Mantinea Flats area are proposed to extend into the nature reserve
- unknown impacts to surface water and groundwater hydrology of the planning area, from land clearing and water abstraction, either from the Ord River or from groundwater sources, and within ORIA Stage 1 and Stage 2
- unknown impacts of increasing nutrients and non-nutrient contaminants (for example, pesticides and herbicides) to the ecology of the river from ORIA Stage 1 and Stage 2, including bioaccumulation. Of serious concern is the impact from the herbicide Atrazine, bioaccumulation of the insecticide Endosulfan and bioaccumulation of DDE (dichlorodiphenyldichloroethylene) in reptiles, affecting the thickness of eggs resulting from the residual effects of the historical use of DDT (dichlorodiphenyltrichloroethane)[9]
- potential for invasion of weed crop species into the planning area
- inconsistency with the purpose of a nature reserve.

Ord River Irrigation Area next to the planning area. Photo – Bok Ho/DEC

[9] *Use of DDT has been banned in Australia since 1987.*

Desired outcome

- Minimal impacts from water resource use on the values of the planning area.

Management actions

1. Issue licences as required under the CALM Act for water extraction from bores and other water sources located within the planning area.
2. Refer proposals that require or effect water resources that may adversely impact upon the values of the planning area to the EPA for consideration of assessment under the EP Act, ensuring consultation with DoW and the Water Corporation.
3. Refer proposals to the Conservation Commission, to provide advice to the Minister for Environment.

20. Public utilities and services

The provision of new services and infrastructure has the potential to impact on the natural and cultural values of the planning area and, depending on their location and type, can result in several significant management problems. Such impacts may include the clearing of vegetation, introduction and spread of weeds and disease, increased susceptibility to fire, visual impacts and the destruction of important habitats. Under the CALM Act provision of such services must be compatible with the objective of a nature reserve.

To limit management problems such as those referred to above, it is preferable that all utility infrastructure not servicing the planning area itself is accommodated outside of the reserves. For example, Parry Creek Road Reserve has been excised from Parry Lagoons Nature Reserve, and from the Ramsar site. This road reserve provides a single infrastructure corridor across the nature reserve, with the expectation that all services for the Mantinea Flats irrigation development will be installed within the road reserve. This would also apply to any future water supply for Wyndham town site from the Ord River.

A Telstra telecommunications radio repeater tower is located in Reserve 39016, within the boundary of Parry Lagoons Nature Reserve. This reserve is vested with the Australian Telecommunications Commission for the purpose of ‘communications’.

Desired outcome

- Minimal impacts from the installation and maintenance of public utilities on the values of the planning area.

Management actions

1. Encourage all new public utilities and services to be located outside of the reserves.
2. Refer proposals that may adversely impact upon the planning area to the EPA for consideration of assessment under the EP Act.
3. Refer proposals to the Conservation Commission to provide advice to the Minister for Environment.

21. Rehabilitation

Rehabilitation is the establishment of a stable, self-perpetuating ecosystem following disturbance, consistent with the purpose for which the area is managed. Rehabilitation within the planning area will be implemented following exploration and mining, road works, raw material extraction, track closure, recreational events, recreational site closure, activities associated with fire suppression or intense fires.

DMP apply conditions to mineral tenements, which highlight rehabilitation requirements and rehabilitation programs. A tenement holder may therefore be required to rehabilitate disturbed areas

resulting from exploration and mining operations. In cases where other agencies or organisations have been responsible for disturbance within the planning area, it is the department's policy that the organisation is accountable for rehabilitation of these areas to a suitable standard. In such cases, the cost of rehabilitation should also be borne by that organisation.

Natural regeneration of vegetation from seed, through appropriate site and topsoil management, is preferable, where feasible, to planting of seedlings. Tracks, drill pads and disturbed recreation sites should be ripped where possible and access prevented to allow establishment of surrounding local plant species. Replacement of cleared vegetation and topsoil over the disturbed area is critical to replenish the seed bank within the soil and obtain an adequate rehabilitation outcome.

Desired outcome

- Degraded areas being restored to a condition resembling the natural environment within the local vicinity.

Management actions

1. Coordinate rehabilitation works with weed control, fire management and cattle exclusion to allow natural regeneration wherever possible.
2. Utilise plant stock or seed of local provenance where active rehabilitation is required.

Brolgas (*Grus rubicunda*) at Marlgu Billabong. Photo – Laurina Bullen/DEC

Involving the community

Community involvement is an integral part of the department's operations, including the development and implementation of this management plan. A key outcome for the department is to develop community awareness and appreciation of the state's natural environment and biodiversity, and promote community involvement in and support for its protection and conservation.

To date, the community has been involved in the preparation of this management plan by providing initial comments on the issues within the planning area, via written submissions and consultation meetings.

Ongoing community support is essential for the successful implementation of the approved final management plan. The involvement and support of Aboriginal people, adjacent landowners and managers, planning area users, tour operators and interest groups is important to the conservation of the planning area's values, and to provide more effective and integrated management of issues that are influenced by activities beyond the boundaries of reserves (such as fire, weeds and introduced animals).

Working together with Aboriginal people to 'care for country' will assist heritage preservation and conservation of the environment, as well as enrich cross-cultural awareness.

Volunteer activities are encouraged and supported within the planning area, and community groups, local schools and universities are encouraged to take part in volunteer activities such as waterbird surveys, water monitoring, rehabilitation, and interpretation and education. The department will seek to coordinate community groups to facilitate such work.

Parry Lagoons Nature Reserve. Photo – Melissa Mazzella/DEC

Management of cross-boundary issues and partnerships

Ord River and Parry Lagoons nature reserves are influenced by activities and events beyond reserve boundaries. As such, management of these reserves cannot be done in isolation, but in context of the broader landscape and catchment. In the landscape context, these reserves are surrounded by ocean and, on land, by pastoral leases, irrigation areas, unmanaged reserves, unallocated Crown land and proposed conservation park (see Map 2). Activities occurring on these lands and events upstream can influence the success of implementation of this management plan and the conservation and protection of key values.

The department's *Good Neighbour Policy* (DEC 2007) outlines several principles for effective neighbour relations. The policy addresses issues such as fences adjacent to DEC-managed lands, fire management, control of weeds and introduced animals, stock on DEC-managed lands, access to DEC-managed lands and others.

Desired outcome

- Effective community involvement in the management of the planning area.

Management actions

1. Continue to encourage, promote and support volunteers and community groups with essential resources to help them carry out their activities.
2. Liaise with the Balanggarra and Miriuwung Gajerrong traditional owners, neighbouring landowners and land managers, local authorities, relevant government agencies and other stakeholders in the management of cross-boundary issues.
3. Notify adjacent pastoralists of cattle located within the planning area, permit pastoralists to muster cattle and advise pastoralists that any stock remaining after mustering will be eradicated.

Boabs. Photo – Melissa Mazzella/DEC

Research

There are many opportunities for research within the planning area. Research by universities and community groups will continue to be encouraged and supported by the department.

It is appropriate that research and monitoring programs involve a wide range of people and groups. The involvement of volunteers, educational institutions and individual researchers can reduce the costs of such programs and assist in providing information to the department and the broader community. However, it is important that all research undertaken within the planning area is coordinated by the department, as this will ensure that efficiency in resource allocation is maximised and priorities identified.

Research in the planning area should focus on the key values and processes (for example, hydrology) and the threats to those values and processes. In terms of the importance of the Ramsar site and international obligation, research is required to identify the point at which changes to these values would result in a significant change to the ecological character of the system.

To identify at what point this would occur, preliminary LACs were developed and presented in the *Ecological character description of the Ord River Floodplain Ramsar site* (Hale 2008) (see Appendix 2). LAC are to be used as a 'trigger values' where, if the LAC is exceeded, it represents that ecological significant change has occurred and management actions are required to protect and maintain the ecological character of the site. The *Ecological character description of the Ord River Floodplain Ramsar site* states that there was incomplete understanding of process and threats, and limited quantitative data on which limits were set (Hale 2008). As such these LACs will require review as more information is gained.

To address knowledge gaps, research and monitoring programs within the planning area should focus on understanding the mechanisms of impacts on the key values and seek to make the unknowns, known. Appendix 3 represents the knowledge gaps and Appendix 4 show the monitoring needs for the Ord River Floodplain Ramsar site which need to be taken into consideration when setting research and monitoring priorities and project goals.

Turtle tagging at Cape Domett. Photo – Allan Thomson/DEC

In the case of management plans, research and monitoring should assist in meeting the requirements of the key performance indicators. This will include gaining a better understanding of those values identified as being most at risk and management practices most likely to have adverse impacts on the key values.

Desired outcome

- Monitor possible impacts associated with implementing the management plan to provide for improved management.

Management actions

1. Conduct or support research on issues and values required to report on this management plan, and the establishment of baseline information that includes:
    - current hydrological processes and water quality to determine adequacy to maintain the ecological character of the planning area
    - macroinvertebrate indicator species to determine water quality and detect levels of change
    - native plants that are rare, threatened or in need of special protection
    - vegetation condition and composition and any levels of change in condition and composition
    - abundance and composition of key fauna species and detect levels of change
    - threatening processes, such as fire and introduced plants and animals
    - the impacts of groundwater extraction within the planning area and from adjacent areas, particularly Mantinea Flats irrigation area
    - visitors' use of the area and its impacts.
2. Provide support for cultural heritage research of the reserves and incorporate traditional custodians' cultural knowledge in the management of the reserves.

Billabong life. Photo – Laurina Bullen/DEC

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Personal communications

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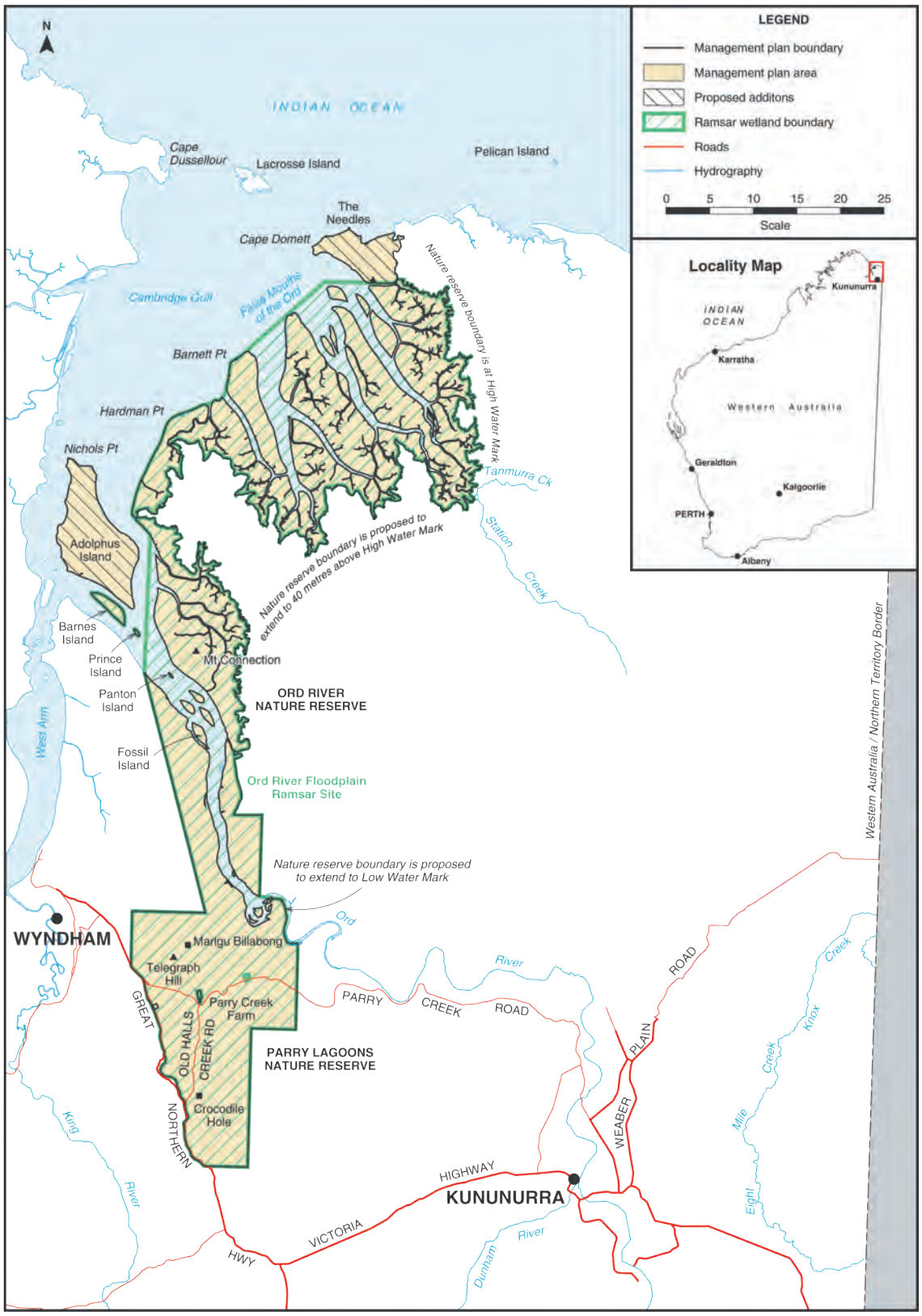
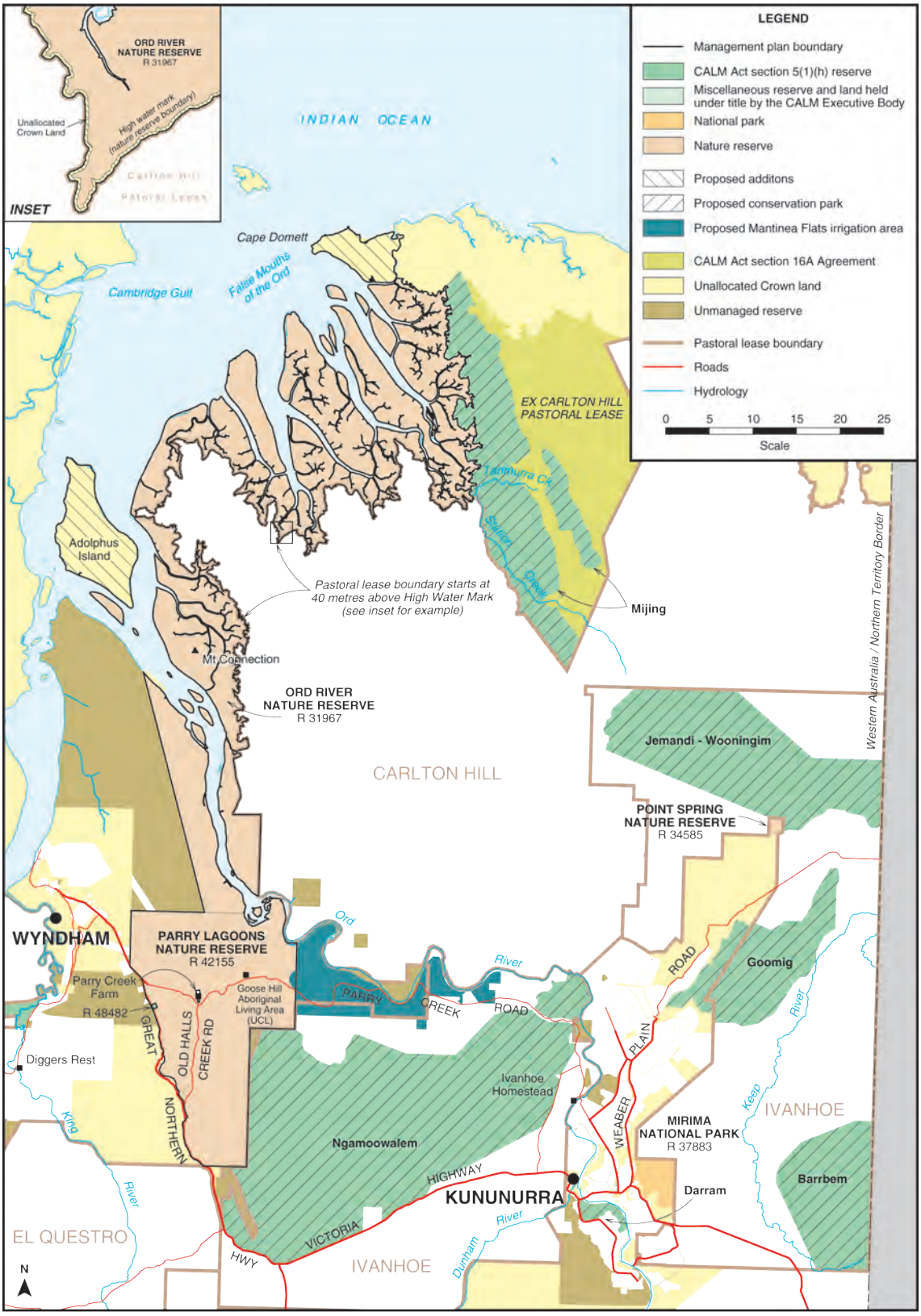
Map 1 Management plan area



Map 2 Land tenure



Appendix 1 Criteria for Ramsar listing

The Ord River Floodplain Ramsar site was listed as a Wetland of International Importance under the Convention on Wetlands in 1990. The Ramsar site originally met four of the six qualifying criteria.

At the time of listing, the site had already been subject to significant hydrological alteration because of the construction of the Kununurra Diversion Dam in 1963 and the Argyle Dam in 1973 for water regulation and development as a part of the Ord River Irrigation Area Stage 1. Although further hydrological alteration occurred with the lifting of the Argyle Dam wall in 1995 for hydropower generation, the ecological characteristics of the Ramsar site must be maintained as they were when originally listed in 1990.

Following refinements, in 2005 and 2006, to the original qualifying criteria, plus the collection of additional data for the site, the Ord River Floodplain Ramsar site has been reviewed to meet the following seven of the nine qualifying criteria (Hale 2008):

Criteria 1

The site represents the best example of wetlands associated with a floodplain and estuary of a tropical river system in the Kimberley Region of WA. In addition, the False Mouths of the Ord contain the most extensive mudflat and tidal waterway complex in WA, and the wetland grasslands at Parry Lagoons are the most extensive vegetation community of this type in WA (CALM 1998).

Criteria 2

The freshwater sawfish (*Pristis microdon*), the green sawfish (*Pristis zijsron*) and the Australian painted snipe (*Rostratula australis*), all recorded within the site, are listed as vulnerable under the Commonwealth EPBC Act. The site is also one of only two known habitats in WA for the nationally endangered northern river shark (*Glypis* sp.) (Thorburn and Morgan 2004).

Criteria 3

The site contains an extensive and diverse mangrove community containing 16 of the 18 species of mangrove known to occur in WA. These mangroves are important habitat for several species of birds restricted to mangrove forests in WA. This includes a population of black butcherbird (*Cracticus quoyi*) that breeds in the area, which is the only population of its kind in WA (Johnstone 1990).

Criteria 4

The site supports:

- the critical life stage of migration: annual use by large numbers of many species of migratory animals (birds and fish)
- the critical life stage of drought refuge: seasonal influx of large numbers of waterbirds from dried out wetlands in surrounding areas, and periodic massive influx from wider regions during drought
- the critical life stage of breeding: 14 species of wetland-dependent birds, saltwater and freshwater crocodiles and an unknown number of fish.

Criteria 5

Surveys conducted at Parry Lagoons in the 1980s regularly recorded more than 20,000 birds in this portion of the Ramsar site alone. Much of the area is difficult to survey, but there is sufficient evidence to support the criterion of '*regularly supports 20,000 waterbirds*'.

Criteria 6

Surveys from the 1980s indicated that maximum counts for two species exceed the one per cent population thresholds (Wetlands International 2006):

- plumed whistling duck (*Dendrocygna eytoni*) – maximum count 15,000 (one per cent = 10,000)
- little curlew (*Numenius minutus*) – maximum count 2,500 (one per cent = 1,800).

Based on available habitat, wetland condition and threats—which are probably unchanged since the 1980s—threshold-meeting numbers of these two species can be expected to still occur in the Ramsar site. In addition, it is likely that several other waterbird species would meet this criteria if comprehensive surveys were conducted at appropriate times of the year.

Criteria 8

The site is important as a nursery, breeding and/or feeding ground for at least 50 species of fish and a migratory route for 15 species that are known to be diadromous.

Appendix 2 Limits of acceptable change for the Ord River Floodplain Ramsar site

Component/process	Baseline/supporting evidence	Limit of acceptable change *
Hydrology	Flooding of riparian vegetation in the wet season to: support large bodied fish; maintain carbon sources to the river and estuary; and maintain native riparian vegetation communities (Braimbridge and Malseed 2007)	Wet season flows sufficient to provide: 4 or more spells over 125m3/s, 2 or more spells over 200m3/s and at least one over 300m3/s. Total annual durations of at least 10, 5 and 1 day(s) for 12 m3/s, 200 m3/s and 300m3/s spells respectively
	Peak flows in the Ord River to maintain inundation of Parry Lagoons including the floodplain and to scour sediment build-up in the lower Ord River and estuary. Braimbridge and Malseed 2007 recommended a Target ARI for peak events in the vicinity of 3,700 to 4,000m3/s every 27–35 years. However, given that connectivity between Parry Lagoons and the estuary and river is important for ecological processes and fish breeding, this may not be conservative enough to maintain the ecological character of the site	Data deficient, however connectivity between Parry Lagoons and the estuary every 3–5 years is optimum for maintaining ecological character
	Flows in Parry Creek to maintain inundation of Parry Lagoons to support flora and fauna	Data deficient – baseline must be established before limits can be set. However annual inundation is essential
Nutrients	The estuary (which includes the Ord River within the Ramsar site) is highly productive and efficient in cycling and exporting nutrients (Parslow et al. 2003). The system requires a minimum nutrient load to maintain productivity; however, high loads of bioavailable nutrients entering the system from upstream irrigation could have a detrimental effect	Median nutrient concentrations within the Ord Estuary and Parry Lagoons of: < 50g/L nitrate-nitrite and < 20g/L phosphate. To be revised when further data becomes available
Dissolved oxygen	The estuary are well mixed and baseline dissolved oxygen concentrations range between 90–110% saturation	Dissolved oxygen concentrations in the estuary no less than 90% saturation

Component/process (continued)	Baseline/supporting evidence	Limit of acceptable change *
Salinity	Greatest mangrove diversity occurs in areas that experience moderate salinity; rather than prolonged exposure to freshwater (Ball et al.1997). Red Mangrove is tolerant of high salinities, but is displaced by other species in fresher conditions (Duke et al. 1998)	Salinity during the dry season in the Estuary and False Mouths of the Ord to average 30–35ppt
	Little is known of the salinity tolerance of the sedge/grasslands and aquatic vegetation at Parry Lagoons. Limits have been set based on existing baseline data	Annual median salinity in Parry Lagoons < 1ppt
Toxicants	Two agrichemicals of concern, Atrazine and Endosulphan have ANZECC (2000b) trigger values. The values for 99% protection have been applied as this site is considered to be of high conservation value	Atrazine < 0.7g/L Endosulphan < 0.03g/L
Primary responses		
Phytoplankton	The Ord River Floodplain Ramsar site is driven by phytoplankton / mircrophytobenthos primary production (WRC 2003). Baseline data of chlorophyll a concentrations is limited to a 15-month period in the estuary reaches (Parslow et al. 2003)	Annual median chlorophyll a concentrations 10–15g/L (note: this is an estimate based on limited data and should be reviewed with additional monitoring)
Mangrove	Mangrove extent within the Ramsar site is approximately 26,000ha. There are 14 species of mangrove	Mangrove extent > 26,000ha Mangrove species 14. No significant change in mangrove distribution and zonation
Sedge/grassland	Current extent and community composition not known	Baseline must be established before quantitative limits can be made. No significant change in community composition or extent
Aquatic vegetation	Current extent and community composition not known	Baseline must be established before quantitative limits can be made. No significant change in community composition or extent
Key communities		
Invertebrates	Insufficient information to set a baseline	Baseline must be established before quantitative limits can be made. No significant change in community composition or abundance

Component/process (continued)	Baseline/supporting evidence	Limit of acceptable change *
Fish	Insufficient information to set a baseline with the possible exception of barramundi and threadfin salmon based on commercial fishing data. However, total catch of barramundi has decreased substantially since the time of listing (Fisheries WA 2003–2007), but without Catch per Unit Effort Data it is not possible to determine if this is a reflection of the population	Baseline must be established before quantitative limits can be made. No significant change in community composition or abundance
	Significant species such as the freshwater sawfish, green sawfish and northern river shark require additional protection. However, without population estimates, quantitative limits are difficult to set	Baseline must be established before quantitative limits can be made
Wetland-dependent birds	Abundance, breeding and species composition is data deficient, with quantitative counts limited to 2 years prior to listing and 1 since. Preliminary, LAC set based on Ramsar criteria and reason for listing	In a majority of the years in which the Parry Floodplain Wetlands is extensively inundated, the system supports: Wetland dependent birds Abundance, breeding and species composition is data deficient, with quantitative counts limited to 2 years prior to listing and 1 since. Preliminary, LAC set based on Ramsar criteria and reason for listing In a majority of the years in which the Parry Floodplain Wetlands is extensively inundated, the system supports: • 20,000 waterbirds • substantial numbers of migratory shorebirds • substantial breeding by waterbirds • large numbers of plumed whistling-duck and little curlew • at least occasional (1 in 20-year) occurrence of Australian painted snipe provided that appropriately frequent, systematic and comprehensive surveys of waterbirds have been conducted at these times
Crocodiles	Mean population estimates for the saltwater crocodile = 80 and freshwater crocodile = 400 in the lower Ord River	No significant change in mean populations for each of these species

Source: Hale 2008

* Where ‘no significant change’ is used in the context of LAC, this will need to be based on exert opinion of experienced resource managers/ecologists.

Appendix 3 Knowledge gaps for the Ord River Floodplain

Component/process	Knowledge gap	Recommended action
Hydrology	Arguably the most significant knowledge gap for this site is the role of Parry Creek in inundation of Parry Lagoons (and associate floodplain). Since regulation, it is likely that inundation from local catchments and Parry Creek is the most significant and regular pathway for flooding of the site. However, there is no data on timing, frequency, duration or extent of flooding	A high resolution digital elevation model (compiled from Lidar data) exists for Parry Lagoons. This DEM could be used, together with hydrological monitoring in Parry Creek to develop a hydrological model of inundation of the floodplain
	While the hydrology of the river upstream of the Ramsar site has been characterised, little is known of the hydrology within the site, especially in the estuary and False Mouths of the Ord	Hydrological monitoring of the estuary (tide gauges) linked to water quality (see below)
Water quality	Water quality information for the site is based on a single 15-month survey (Parslow et al. 2003). Little is known about interannual variability over long time scales	Regular water quality monitoring (salinity, nutrients and pH) at Parry Lagoons and within the estuary
Vegetation communities	With the exception of the extent of mangroves, there is no quantitative information on the extent and composition of vegetation communities within the Ramsar site	Mapping of extent of vegetation (remote sensing) and community composition (ground surveys in both wet and dry seasons) to set a baseline against which change can be assessed
Mangrove communities	Apart from limited bird surveys there is no information on the species and communities that inhabit the mangrove creek systems such as those of the False Mouths of the Ord	Comprehensive ecological investigation of the False Mouths of the Ord
Fish	Current community composition and abundance of fish within the site. No surveys dedicated to the estuary could be found	Annual fish surveys
Waterbirds	The abundance and species of waterbirds that regularly use Parry Lagoons in the wet season. Current knowledge is based on surveys in the 1980s, 1993 and a single survey in 2005	Annual waterbird surveys, including both wet season (most critical) and dry seasons

Component/process	Baseline/supporting evidence	Limit of acceptable change *
Threatened species	The site is thought to support 4 species listed under threatened species legislation (freshwater sawfish, green sawfish, northern river shark and Australian painted snipe). However, records for these species are based on isolated surveys	Investigation into the status of these threatened species within the site

Source: Hale 2008

Appendix 4 Monitoring needs for the Ord River Floodplain

Component/process	Purpose	Indicator	Locations	Frequency	Priority
Hydrology	Establishment of baseline and then detection of change	Inundation frequency and extent of Parry Lagoons Flow (m3/s) at Parry Creek	Across Parry Lagoons and Floodplain	Flow – continuous Inundation – annual	Highest
	Detection of change	Flow (m3/s) Stage height (metres – Australian Height Datum)	Existing monitoring locations in the Ord Estuary and Cambridge Gulf (Robson et al. 2008)	Continuous	High
Geomorphology	Detection of change	Cross-channel profile	Estuarine reach of the Ord River at locations of Wolanski et al. (2001)	Annual	Moderate
Water quality – general	Establishment of baseline and then detection of change	Nutrients (total nitrogen, ammonium, nitrate-nitrite, total phosphorus, orthophosphate); salinity, dissolved oxygen, suspended sediments	At hydrological monitoring points	Optimum – event based Monthly – minimum	High
Water quality – toxicants	Detection of change	Agrochemicals including Endosulphan and Atrazine	Existing monitoring locations	Monthly	High
Vegetation – extent	Establishment of baseline and then detection of change	Extent of broad vegetation types (remote sensing)	Entire Ramsar site	Every 5 years	High
Vegetation – community composition	Establishment of baseline and then detection of change	Community composition of vegetation types (field surveys)	Entire Ramsar site	Every 5 years	High
Water quality – general	Establishment of baseline and then detection of change	Nutrients (total nitrogen, ammonium, nitrate-nitrite, total phosphorus, orthophosphate); salinity, dissolved oxygen, suspended sediments	At hydrological monitoring points	Optimum – event based Monthly – minimum	High

Component/process (continued)	Purpose	Indicator	Locations	Frequency	Priority
		Endosulphan and Atrazine			
Vegetation – extent	Establishment of baseline and then detection of change	Extent of broad vegetation types (remote sensing)	Entire Ramsar site	Every 5 years	High
Vegetation – community composition	Establishment of baseline and then detection of change	Community composition of vegetation types (field surveys)	Entire Ramsar site	Every 5 years	High
Weeds	Determination of impact	Location, extent, species	Parry Lagoons	Annual	Low
Macroinvertebrates	Establishment of baseline and then detection of change	Abundance, community composition	Mudflats and shallow wetland areas	Annual	Low
Fish – species	Establishment of baseline and then detection of change	Community composition	Parry Lagoon, Ord Estuary	Annual	Moderate
Fish – abundance	Establishment of baseline and then detection of change	Abundance of key species such as barramundi	Parry Lagoon, Ord Estuary	Annual	High
Waterbirds	Establishment of baseline and then detection of change	Counts and species identifications, breeding observations	Parry Lagoon	Seasonal	High
Mangrove birds	Establishment of baseline and then detection of change	Species identifications and breeding observations	Ord Estuary and False Mouths of the Ord	Annual	Low
Crocodiles	Detection of change	Population estimates	Existing survey locations (CALM 2003)	Annual	High

Source: Hale 2008