

# FLORA AND FAUNA LITERATURE REVIEW OF THE RANGER URANIUM MINE PROJECT AREA - REPORT 1



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*Prepared for: Energy Resources of Australia Ltd*

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## EXECUTIVE SUMMARY

ENV. Australia Pty Ltd was commissioned by Energy Resources of Australia Ltd in January 2012 to undertake a literature review of flora and fauna data of the Ranger uranium mine/ Ranger Project Area, which is located approximately 250 km east of Darwin in the Top End of the Northern Territory. ERA intends to commence Pre-feasibility Studies and regulatory approvals for the establishment of an underground mine (Ranger 3 Deeps) to extract and process uranium ore. Aboveground disturbance, outside and immediately adjacent to the current operational footprint, will consist of a discrete footing or foundation for several vent raises for the purpose of maintaining air quality in the underground facility.

The primary focus of this review is terrestrial flora and vertebrate fauna, with a secondary focus on aquatic flora and fauna. This report has synthesized a total of 18 documents that have reported on flora survey work, 26 reports that have presented results of fauna surveys, three reports that have documented aquatic flora and fauna survey work and seven documents that reviewed previous terrestrial and aquatic flora and fauna work.

Impacts to terrestrial flora and vertebrate fauna associated with the proposed vent raises would be insignificant in a local and regional context. This is because of the limited extent of the proposed area of disturbance for the vent raise and associated surface infrastructure, the location of vent raises in an area already significantly disturbed by recent exploration activity and the now discontinued practice of “land application” (disposal of pond water). Furthermore, given that the vent raises will be situated away from the Magela Creek there is unlikely to be any impacts to the biologically rich aquatic flora and fauna in the creek.

A number of conservation significant species (including a relatively large number of mostly bird species which are listed under various migratory agreements) have been recorded on the RPA during previous surveys. The two most notable of these, the Endangered Northern Quoll *Dasyurus hallucatus* and the Vulnerable Partridge Pigeon *Geophaps smithii*, are listed under both the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Territory Parks and Wildlife Conservation Act* (TPWC Act).

The Northern Quoll population has undergone dramatic declines in the Top End as a result of ingesting the toxic Cane Toad and in many areas of the mainland such as Kakadu National Park has become almost extinct. Several recent surveys on the Ranger Project Area have failed to detect it, suggesting that it is most probably extinct on the Ranger Project Area.

The only EPBC Act listed fauna species (Partridge Pigeon) still known with certainty to occur on the RPA, is a mobile species and will therefore be unaffected by the clearing of such small areas of vegetation associated with the proposed project.

# 1 INTRODUCTION

## 1.1 THE PROJECT

ENV. Australia Pty Ltd (ENV) was commissioned by Energy Resources of Australia Ltd (ERA) in January 2012 to undertake a literature review of flora and fauna data of the Ranger Project Area (RPA), which is located approximately 250 km east of Darwin in the Top End of the Northern Territory (NT) (Figure 1).

ERA intends to commence Pre-feasibility Studies (PFS) and regulatory approvals for the establishment of an underground mine to extract and process uranium ore from the Ranger 3 Deeps ore body, situated east and south-east of Pit 3. It is envisaged that the construction and infrastructure associated with the proposed underground mine will be constrained to the vicinity of the decommissioned Magela Land Application Area (MLAA). Disturbance will consist of discrete footings or foundations for each vent raise, for the purpose of maintaining air quality in the underground facility; and power and access tracks to each vent raise to undertake repairs and maintenance. Existing tracks in the MLAA would be used where practical to reduce the need for further clearing.

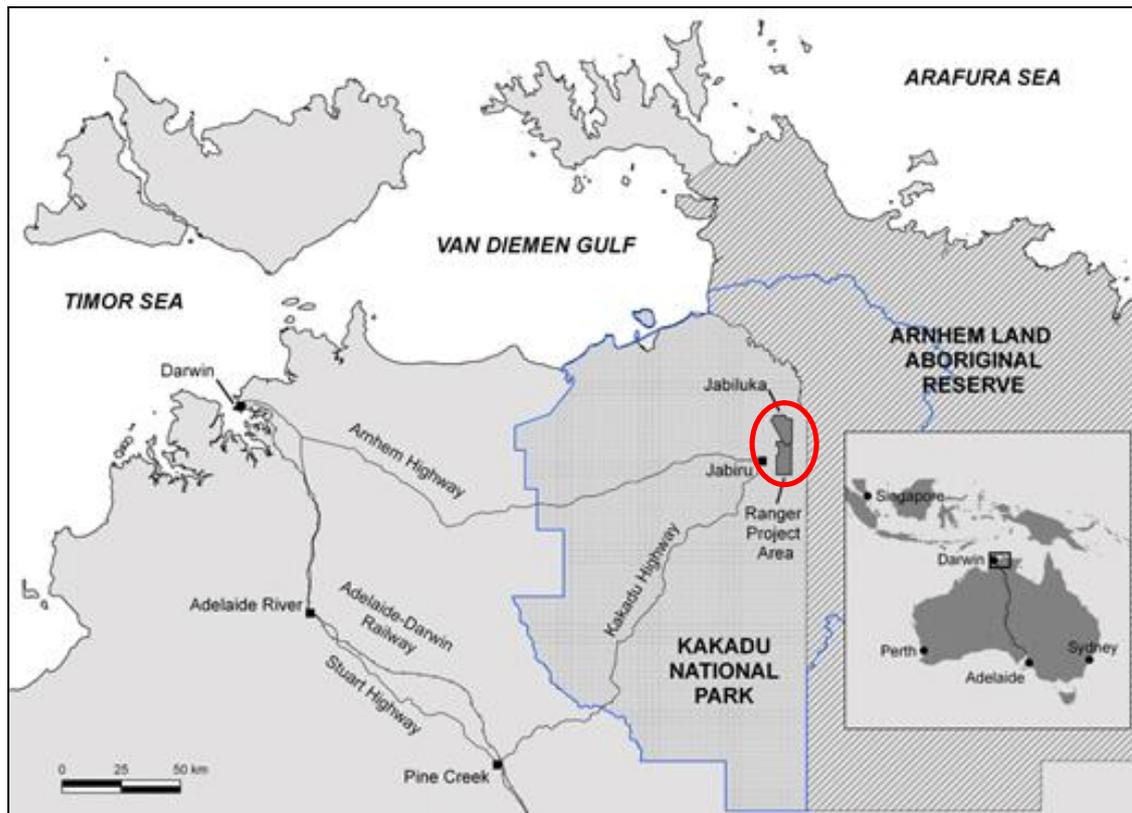


Figure 1: Location of the Ranger Project Area (RPA) in relation to Kakadu National Park (Kakadu) and Darwin (figure provided by ERA).

## 1.2 OBJECTIVES

ERA is presently constructing an exploration decline, and commencing a study to assess a potential underground mine. Should the mine proceed it is envisaged that associated aboveground infrastructure would include several vent raises (exhausts for the mine ventilation system); a literature review was requested to support these studies and to assess data gaps and/or the requirements for further surveys and monitoring. Two reports have been produced as requested by ERA:

Phase 1 - A review of flora and fauna data on the RPA and in the vicinity of the proposed project infrastructure.

Phase 2 - Identify and assess knowledge gaps, make recommendations and design an appropriate monitoring programme.

### Phase 1

The primary focus of this report is to review the existing literature of terrestrial flora and terrestrial vertebrate fauna surveys and (with some reference to aquatic flora, fauna and ants) monitoring programmes that have been undertaken on the RPA.

However, some of the studies have been done on the RPA and Jabiluka Mineral Lease No 1 (approximately 20 km north of the Ranger operation), and others include work from Kakadu National Park (Kakadu). The majority of the literature is from ERA surveys (including annual bird watch data). Furthermore, less focus is given to aquatic impacts because there are unlikely to be impacts on aquatic flora and fauna as a result of the location of the proposed vent raises being sufficiently distant from riparian tracts and within the footprint of the MLAA. In general, recent literature was reviewed as it provides up to date content, (for example, the recent annual vegetation monitoring in land application areas that once occurred on the RPA). Much of the earlier work is made redundant by the recent studies.

The purpose of this literature review is to also consider the following points:

- a) Determine if the previous surveys and data are sufficient to address the following key considerations in respect to assessment of potential impacts on flora and fauna arising from progression of an underground mine:
  - Describe the habitats, communities and animal/plant species within them, noting significance of the biological diversity (as per the Convention on Biological Diversity), and current condition;
  - Ecological relationships, including the conservation status of species or associations to be disturbed by the activity (including species and communities listed under the EPBC Act);

- Other sensitive environments or areas of special significance (breeding sites, seasonal habitats, wetlands, etc.) in the footprint of the proposed activity and potentially affected by the proposed activity (downstream, down-wind, etc.);
- Introduced flora and fauna;
- The extent to which the environment is already affected by existing mining (and exploration) activities.

It is important to note that some aspects of the biological environment are difficult to address and could only be discussed superficially, if at all, given the lack of knowledge on the understanding of ecological relationships and cumulative impacts, particularly given the complex nature of such ecological systems.

### Phase 2

The Phase 2 report will “identify and assess knowledge gaps, make recommendations for the design of an appropriate monitoring programme”, addressing points b) through to e) (below), as they are more pertinent to the broad objectives of Phase 2.

- b) Identify sites targeted to habitats;
- c) Determine the adequacy of previous surveys and the potential to integrate that data into new survey studies, as required;
- d) Develop a scope for further studies (if required and relative to the proposed project area);
- d) Establish optimum sampling times and locations for priority species and ongoing monitoring sites; and
- e) Identify fauna expertise required for further studies e.g. external consultants.



Figure 2: Location within which surface vent raise infrastructure is anticipated (outlined in yellow) on the Ranger Project Area (RPA) (figure provided by ERA).

## 2 REGIONAL SETTING

### 2.1 ENVIRONMENTAL SETTING

The RPA is 79 km<sup>2</sup> and is surrounded by Kakadu which comprises an area of 19,804 km<sup>2</sup> and is Australia's largest National Park. The World Heritage Listed Kakadu National Park is a unique region with exceptional natural and cultural heritage values. Kakadu includes a large area that is listed as a wetland of international importance under the Ramsar Convention. Nearly 1,600 plant species have been recorded in Kakadu, including about 17 species considered rare or threatened. A large proportion of the vegetation in Kakadu is dominated by eucalypt woodland. Kakadu contains at least 271 bird species (over one third of Australia's bird fauna), 77 mammal species (about one quarter of Australia's land mammals); 132 reptile species and 27 frog species. More than 246 fish species have been recorded in the tidal and freshwater areas within the Park making it the most speciose region for freshwater fish in Australia. Kakadu is also largely intact. Unlike many other areas of Australia, Kakadu still has almost all the plant and animal species thought to have been present at the time of European settlement (Director of National Parks 2007).

The Ranger 3 Deeps project will be located in the current RPA operational footprint which is shown in grey in Figure 3. The main vegetation/ habitat types on the RPA are woodland and open forest, which are mostly co-dominated by *Eucalyptus miniata* and/or *E. tetradonta* (Figure 3) and these are the same habitat types that occur in the area proposed to be disturbed as a result of infrastructure associated with the vent raise. The RPA is surrounded for the most part by vast unbroken and undeveloped tracts of the same eucalypt woodlands and open forest savannas that cover at least 180,000 km<sup>2</sup> in the NT alone (Woinarski et al. 2005). The topography of the RPA is relatively simple and as with vegetation, mirrors that of the region as a whole. To the east of the RPA lies the upland sandstone plateau and escarpment of western Arnhem Land.

The Interim Biogeographic Regionalisation for Australia (IBRA) divided Australia into 85 bioregions based on major biological and geographical/geological attributes (Thackway & Cresswell 1995). These bioregions were further subdivided into 403 subregions, as part of a refinement of the IBRA framework (Department of Sustainability, Environment, Water, Population and Communities [SEWPaC] 2011). The RPA is located in the north east corner of the Pine Creek Bioregion. Land types of this bioregion are mainly hilly to rugged ridges with undulating plains. Vegetation communities include eucalypt woodlands with patches of monsoon forests.

Until recently there were no EPBC Act listed threatened ecological communities in the region. However, in November 2011 the Arnhem Plateau Sandstone Shrubland Complex Ecological Community was listed as Endangered because it is threatened by inappropriate fire regimes and invasion by weeds and feral animals (SEWPaC 2012). This community does not occur on the RPA, but it does occur in neighbouring Kakadu

and is in close proximity on the eastern and southern sides of the RPA (Figure 4). It should be noted that this community is also likely to occur on the Jabiluka Lease which is also managed by ERA.

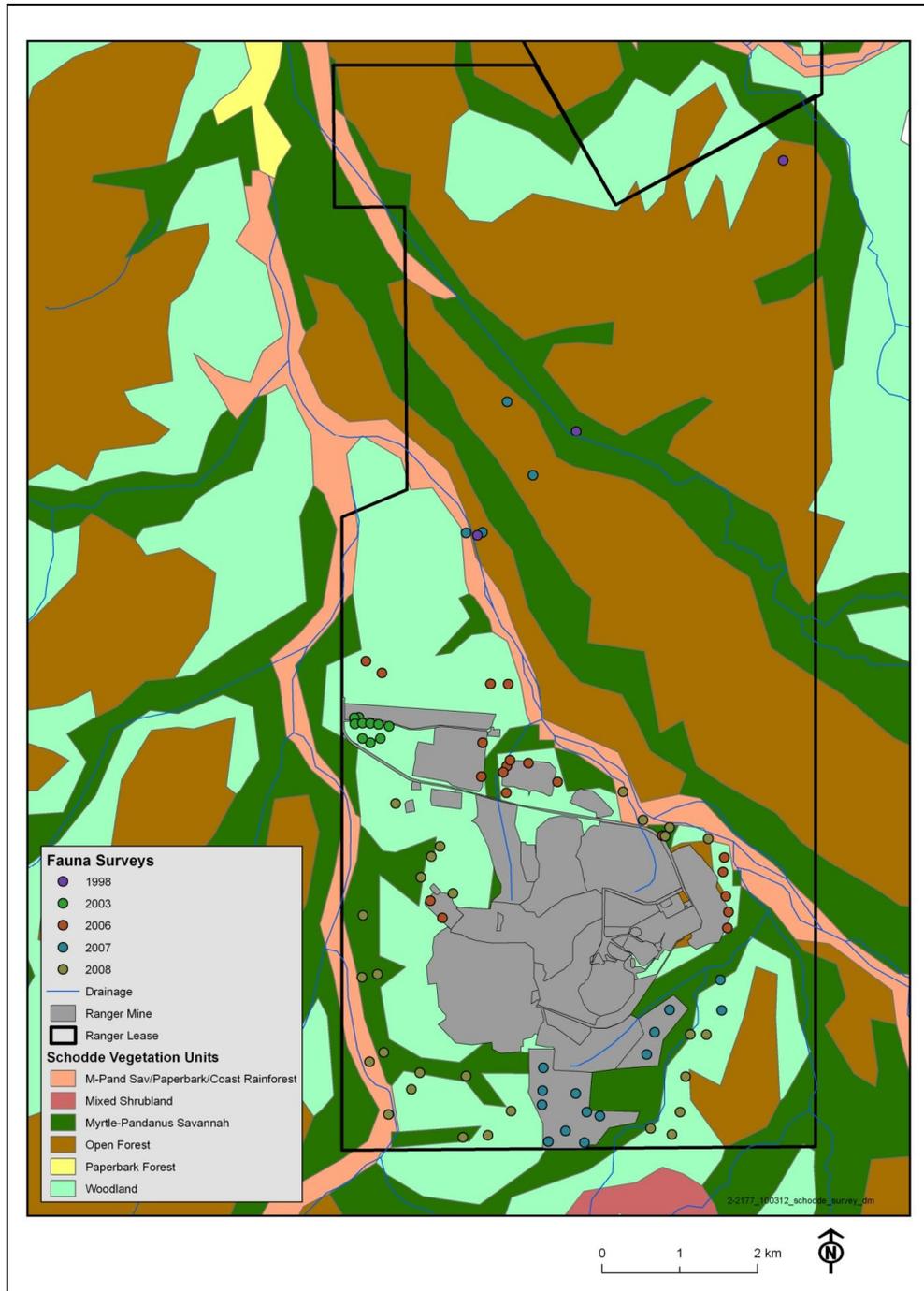


Figure 3: Schodde *et al.* (1987) vegetation units on the RPA and location of past fauna surveys (most of which also include a flora component) (figure provided by ERA).

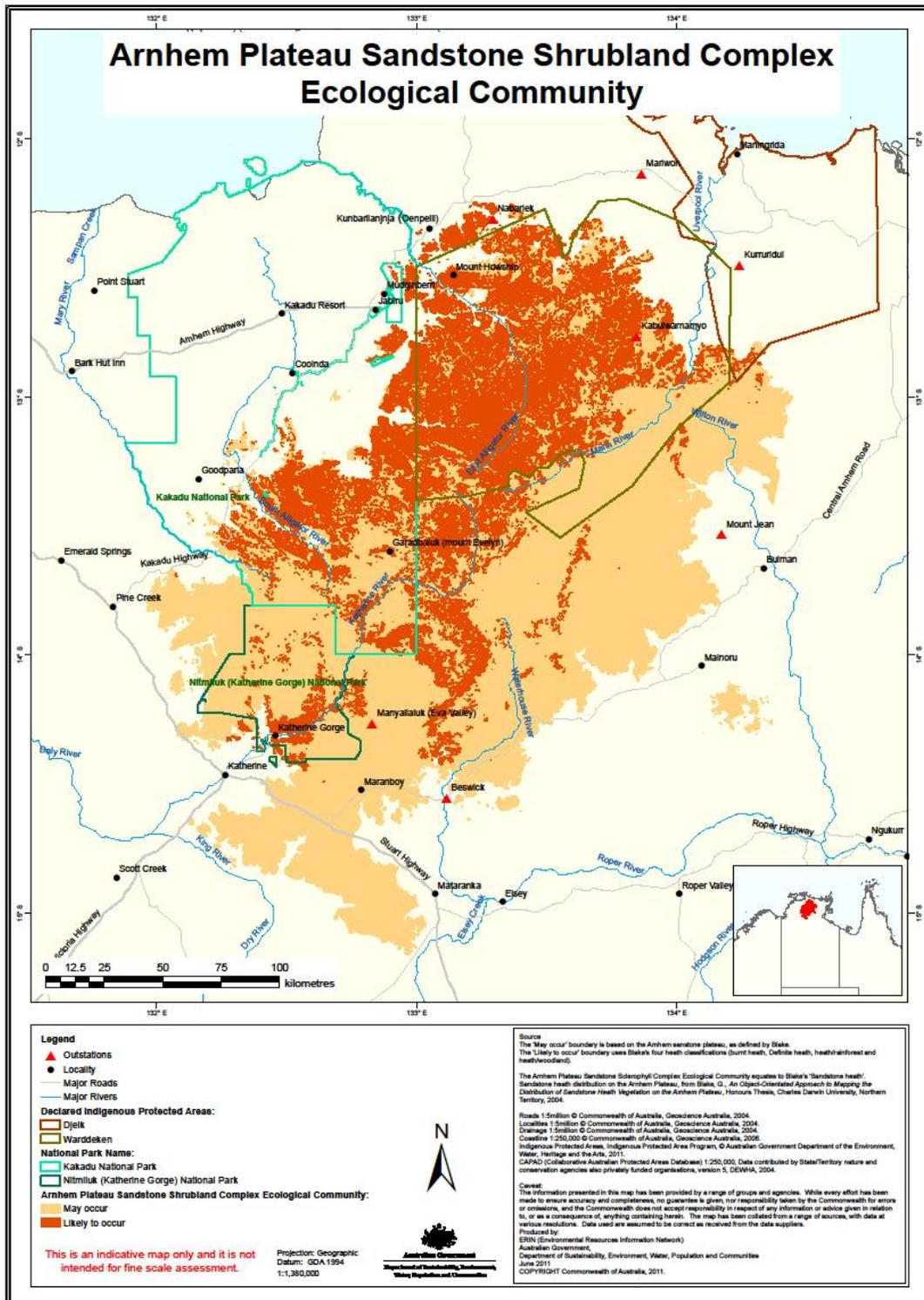


Figure 4: Location of the Arnhem Plateau Sandstone Shrubland Complex Ecological Community which is listed as Endangered under the EPBC Act. (Figure sourced from SEWPaC at <http://www.environment.gov.au/biodiversity/threatened/communities/maps/pubs/11-map.pdf>).

## 2.2 CLIMATE

Climate in this region is characterised by two distinct seasons, a hot and humid wet season (from November to April) when approximately 90% of the rainfall occurs, and a cooler dry season (from May to October) characterised by little to no rain (Figure 5). Jabiru airport has a mean annual rainfall of 1629 mm and temperatures are high all year round with mean monthly minima and maxima ranging from 18.5 to 31.9°C in July and 24.9 to 36.8°C in November (Jabiru airport weather station, Bureau of Meteorology, Darwin).

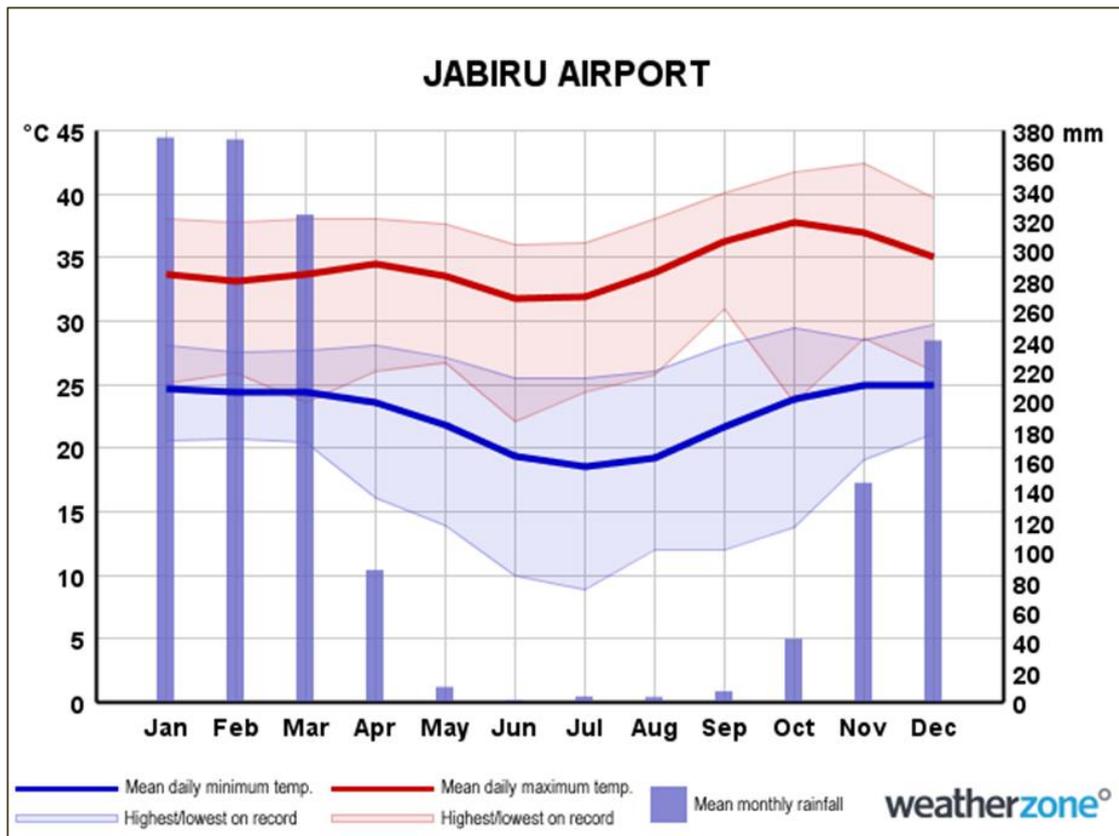


Figure 5: Average long-term (1984-2011) Monthly Rainfall and average Maximum and Minimum Temperatures at Jabiru Airport (Weatherzone.com.au, based on data in BOM 2012).

## 2.3 RELEVANT LEGISLATION

Flora and fauna, habitat, and ecological communities are protected by various legislative and non-legislative measures, which are outlined below. Species listed under these acts are considered either 'conservation significant' or as introduced plants (weeds) in this assessment.

### Legislative Protection

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Territory Parks and Wildlife Conservation Act 2007* (TWPC ACT)
- *Northern Territory Weed Management Act 2001*

It was noted whether birds were covered under international treaties such as:

- China-Australia Migratory Bird Agreement (CAMBA) 1988;
- Japan-Australia Migratory Birds Agreement (JAMBA) 1981;
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) 2007; and
- Bonn Convention for the conservation of migratory species (Bonn) which came into effect in 1979; and whether birds are listed as migratory under the EPBC Act.

Species that are covered by these treaties and acts that have been recorded on site were noted.

### 3 PAST SURVEYS ON THE RANGER PROJECT AREA

There have been a number of terrestrial flora and terrestrial vertebrate fauna surveys and monitoring programmes undertaken on the RPA in the past. The focus of many of these surveys has been for monitoring purposes such as the impact of dry season irrigation on vegetation in the Land Application Areas over time (e.g. Addison and Gardener 2005), or assessing environmental impacts over time through a whole ecosystem approach to monitoring that examined biota in a number of billabongs on the RPA (Corbett *et al.* 2004). While other surveys have focussed on pre-impact baseline information from disturbances associated with clearing of vegetation for infrastructure. Recent examples of this include biodiversity surveys for the Ranger expansion project (Firth 2010a), baseline flora and fauna surveys in new exploration areas (Smith 2009), and baseline flora and fauna surveys in the Corridor Creek Land Application Area (Firth 2008a).

In addition to the examples given above, many of the past surveys included both flora and fauna components (some including aquatic flora and fauna), whereas others have either had a flora or fauna focus. As a result, the previous terrestrial flora and fauna as well as aquatic flora and fauna work below are summarised separately.

#### 3.1 TERRESTRIAL FLORA

In all, 18 documents that include surveys of flora and vegetation elements have been reviewed and summarised below in chronological order from most recent to oldest (Table 1). Additional material (e.g. from scientific journals) has also been used and referenced but not placed in the table because it does not specifically relate to surveys on the RPA. The summary table includes various aspects of the survey/monitoring programme such as the methodologies employed, number of species and whether or not conservation significant or introduced (weed) species were recorded.

Table 1. Summary of flora surveys for the Ranger Project Area.

Flora species codes: N = Native, I = Introduced, T = Total number of species, N/A = Not Applicable. Conservation codes: TPWC = *Territory Parks and Wildlife Conservation Act 2007* (Parks & Wildlife Commission of the Northern Territory 2001), EPBC = *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 1999), EN = endangered, V = vulnerable.

Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded and Weed Species
1. Vegetation Assessment and Closure Requirements of Ranger's Land Application Areas (LAAs) (Addison 2011)	Field survey March/April 2009	Systematic - Quadrat based (dominant species only), health and weed assessment	N/A	N/A
2. Annual Weed Survey of Ranger and Jabiluka 2011 (Gellert & McIntyre 2011)	Field survey May/June 2011	Targeted - Survey of known weed infestations and irrigation lines	I = 44	<ul style="list-style-type: none"> <li>• <i>Stachytapheta sp.</i> Listed under the NT Weed Management Act</li> <li>• 13 Priority weed species</li> </ul>
3. Terrestrial vertebrate fauna and terrestrial flora surveys for REP Option 1 (Firth & Davey 2011)	Field survey May 2010	Systematic - Quadrats and transects	T = 76	None
4. REP Biodiversity surveys, Part A Terrestrial vertebrate fauna and terrestrial flora (Firth 2010a)	Field survey wet/dry season 2009	Systematic - Sampling using quadrats, in addition to desktop review	N = 205 I = 3 T = 208	None
6. Baseline Flora and Fauna Surveys in New Exploration Areas for 2007 (Smith 2009)	Field survey June 2007	Systematic - Quadrats, transect and opportunistic collections	N = 75	None

Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded and Weed Species
7.	Baseline Flora and Fauna Surveys of New Land Application Areas in the Corridor Creek Area (Firth 2008a)	Field survey April 2007	Systematic - Quadrats and opportunistic collections N = 159 I = 9 T = 168	None
8.	Pre-clearance fauna survey of the future trial landform site (Firth 2008b)	Field survey April 2008	Non-systematic – Opportunistic survey along transects N = 69 I = 3 T = 72	None
9.	Site inspection of the proposed extension to Jabiru Airstrip (Firth 2008c)	Field survey conducted July 2007	Non-systematic – Survey and vegetation description N = 47 I = 3 T = 50	None
10.	Baseline Vegetation and Brush-Tailed Rabbit-rat Survey for the New land Application Areas: (Brady <i>et al.</i> 2006)	Field survey July/August 2006	Systematic – Quadrat based for the Vegetation monitoring and for the targeted fauna survey N = 43 I = 34 T = 77	<ul style="list-style-type: none"> <li>• 13 Priority weed species</li> </ul>
11.	Environmental monitoring at Ranger Mine: A whole-ecosystem Approach (Corbett 2006)	Field survey 1994/95	Systematic – Quadrats and opportunistic collections N = 154	None
12.	Vegetation monitoring in ranger's land Application Areas: April 2005 (Addison & Gardener 2005)	Vegetation monitoring	Systematic – Quadrats (Vegetation monitoring) with health assessment N/A	N/A
13.	Monitoring Vegetation in Ranger Irrigation Areas November 2004 (Addison <i>et al.</i> 2005)	Field survey Nov 2004	Systematic – Quadrats (Vegetation monitoring) with health assessment N/A	N/A

Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded and Weed Species
14. Aquatic Studies at Ranger Mine: Whole-Ecosystem Monitoring – Round 2 (Corbett <i>et al.</i> 2004)	Field survey May/June 2001	Systematic – Transects	T = 38	N/A
15. Monitoring vegetation in ranger Irrigation Areas, April 2004 (Welch & Meek 2004)	Field survey April 2004	Systematic – Quadrats (Vegetation monitoring) with health assessment	N/A	N/A
16. Ecosystem reconstruction for the ranger mine final landform – Phase 2 target ecosystem closure criteria (Hollingsworth & Meek 2003)	Survey	Systematic – Grid survey	T = 127	N/A
17. A whole-ecosystem approach to Environmental monitoring: Ranger mine case study (Corbett 2000)	Field survey April/May 1995	Systematic – Transects	T = 102	None
18. Vegetation Habitats Kakadu National Park, Alligator Rivers Region, Northern Territory (Schodde <i>et al.</i> 1987)	Field surveys 1971-1976	Systematic – Mapped vegetation habitats	N/A	N/A

### 3.2 TERRESTRIAL FAUNA

In total, 26 documents that include fauna surveys have been reviewed and summarised in chronological order from most recent to oldest (Table 2). Additional material (e.g. from scientific journals) has been used and referenced but not included in the table because it does not specifically relate to surveys on the RPA. The summary table includes various aspects of the surveys and monitoring programmes such as the methodologies employed and the number of species and whether or not conservation significant or introduced fauna species were recorded.

Table 2. Summary of fauna surveys for the Ranger Project Area.

Fauna species codes: F= frog, R= reptile, B= bird, M= mammal, Mi = migratory EPBC, IN= invertebrates, A= ants, I = introduced. N/A = Not Applicable; and, # = identified during desk top review. Conservation codes: TPWC = *Territory Parks and Wildlife Conservation Act 2007* (Parks & Wildlife Commission of the Northern Territory 2001), EPBC = *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 1999), CR= critically endangered, EN= endangered, V = vulnerable, CAMBA = China-Australia Migratory Bird Agreement, JAMBA = Japan Australia Migratory Bird Agreement, ROKAMBA = Republic of Korea-Australia Migratory Bird Agreement.

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
1.	Terrestrial vertebrate fauna and terrestrial flora surveys for REP Option 1 (Firth & Davey 2011)	Field survey May 2010	Systematic - Quadrats and transects (pit-traps, Elliott & cage traps), bird census, and diurnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 5 (I =1)</li> <li>• R = 10</li> <li>• B = 45</li> <li>• M = 4 (I = 1)</li> </ul>	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU, EPBC &amp; TPWCA)</li> <li>• Rainbow Bee-eater (Mi)</li> </ul>
2.	ERA Birdwatch Events 2011	Field survey 2011	Opportunistic searches	<ul style="list-style-type: none"> <li>• B = 58</li> </ul>	<ul style="list-style-type: none"> <li>• Rainbow Bee-eater (Mi)</li> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> </ul>
3.	Surveys for rock dwelling fauna at Ranger (Firth 2010b)	Filed survey November 2009	Systematic – transects (Elliott traps)	<ul style="list-style-type: none"> <li>• M = 1</li> </ul>	None
4.	Surveys for rock dwelling fauna at Ranger (Firth 2010b)	Field survey April 2010	Systematic – Transects with Elliot traps	<ul style="list-style-type: none"> <li>• M = 1</li> </ul>	<ul style="list-style-type: none"> <li>• Common Rock-rat (first record for the RPA)</li> </ul>
5.	REP Biodiversity surveys, Part A Terrestrial vertebrate fauna and terrestrial flora (Firth 2010a)	Field survey wet/dry season 2009	Systematic - Quadrats and transects (pit-traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 12</li> <li>• R = 27</li> <li>• B = 78</li> <li>• M = 11</li> </ul>	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU, EPBC &amp; TPWCA)</li> <li>• Merten's Water Monitor (VU, TPWCA)</li> </ul>

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
6.	ERA Birdwatch Events 2009	Field survey 2009	Opportunistic searches	<ul style="list-style-type: none"> <li>• B = 75</li> </ul>	<ul style="list-style-type: none"> <li>• Rainbow Bee-eater (Mi)</li> <li>• Common Greenshank (CAMBA; JAMBA)</li> <li>• Glossy Ibis (CAMBA)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> </ul>
7.	Baseline Flora and Fauna Surveys in New Exploration Areas for 2007 (Smith 2009)	Field survey June 2007	Systematic - Quadrats and transects (pit-traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 2 (I = 1)</li> <li>• R = 9</li> <li>• B = 57</li> <li>• M = 4 (I = 2)</li> </ul>	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU, EPBC &amp; TWCA)</li> <li>• Rainbow Bee-eater (Mi)</li> </ul>
8.	ERA Birdwatch Events 2008	Field survey 2008	Opportunistic searches	<ul style="list-style-type: none"> <li>• B = 72</li> </ul>	<ul style="list-style-type: none"> <li>• Rainbow Bee-eater (Mi)</li> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> <li>• Glossy Ibis (CAMBA)</li> <li>• Cattle Egret (CAMBA; JAMBA)</li> </ul>
9.	Baseline Flora and Fauna Surveys of New Land Application Areas in the Corridor Creek Area (Firth 2008a)	Field survey May 2007	Systematic - Quadrats (pit-traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 7 (I = 1)</li> <li>• R = 18</li> <li>• B = 45</li> <li>• M = 7 (I = 2)</li> </ul>	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU, EPBC &amp; TPWCA)</li> <li>• Merten's Water Monitor (VU, TPWCA)</li> <li>• Rainbow Bee-eater (Mi)</li> </ul>
10.	Pre-clearance fauna survey of the future trial landform site (Firth 2008b)	Field survey April 2008	Systematic - Transects (Elliot's, pit-traps and cage traps), bird census, diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 6 (I = 1)</li> <li>• R = 9</li> <li>• B = 32</li> <li>• M = 6 (I = 1)</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU, EPBC &amp; TPWCA)</li> </ul>
11.	Site inspection of the proposed extension to Jabiru Airstrip (Firth 2008c)	Field survey July 2007	Opportunistic site inspection	<ul style="list-style-type: none"> <li>• R = 3</li> <li>• B = 19</li> <li>• M = 1</li> </ul>	None

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
12.	ERA Birdwatch Events 2007	Field survey 2007	Opportunistic searches	• B = 71	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU, EPBC &amp; TPWCA)</li> <li>• Rainbow Bee-eater (Mi)</li> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> <li>• Glossy Ibis (CAMBA)</li> <li>• Cattle Egret (CAMBA; JAMBA)</li> </ul>
13.	Agile Wallabies and irrigation water (Firth 2007)	Field survey September 2007	Systematic - Transects comparing irrigated LAA areas and non-irrigated areas for Agile Wallaby numbers	N/A	None
14.	ERA Birdwatch Events 2006	Field survey 2006	Opportunistic searches	• B = 63	<ul style="list-style-type: none"> <li>• Rainbow Bee-eater (Mi)</li> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> <li>• Cattle Egret (CAMBA; JAMBA)</li> </ul>
15.	Environmental monitoring at Ranger Mine: A whole-ecosystem Approach (Corbett 2006)	Field survey 1994/95	Systematic - Quadrats (pit-traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 15</li> <li>• R = 33</li> <li>• B = 130</li> <li>• M = 12</li> </ul>	None
16.	Baseline Vegetation and Brush-tailed rabbit-rat Survey for the New Land Application Areas: July/August 2006 (Brady <i>et al.</i> 2006)	Field survey July/August 2006	Systematic - Quadrats and transects (pit-traps, Elliott & cage traps), diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• F = 0 (I = 1)</li> <li>• R = 5</li> <li>• B = 61</li> <li>• M = 5</li> </ul>	<ul style="list-style-type: none"> <li>• Partridge Pigeon (VU; EPBC &amp; TPWCA)</li> </ul>

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
17.	ERA Birdwatch Events 2004	Field survey 2004	Opportunistic searches	• B = 61	<ul style="list-style-type: none"> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> <li>• Glossy Ibis (CAMBA)</li> <li>• Cattle Egret (CAMBA; JAMBA)</li> </ul>
18.	Aquatic Studies at Ranger Mine: Whole-Ecosystem Monitoring – Round 2 (Corbett <i>et al.</i> 2004)	Field survey May/June 2001	Systematic - Transects, pit-traps, Elliott & cage traps, bird census, diurnal and nocturnal opportunistic searches and recordings of microbats using AnaBat II	<ul style="list-style-type: none"> <li>• F = 9</li> <li>• R = 12</li> <li>• B = 73</li> <li>• M = 20 (I = 1)</li> </ul>	<ul style="list-style-type: none"> <li>• Northern Quoll (CR EN, TPWCA; EN, EPBC)</li> <li>• Cattle Egret (CAMBA; JAMBA)</li> <li>• Masked Lapwing (Bonn)</li> <li>• Brolga (Bonn)</li> <li>• Green Pygmy Goose (Bonn)</li> <li>• Great Egret (JAMBA; CAMBA)</li> </ul>
19.	ERA Birdwatch Events 2003	Field survey 2003	Opportunistic searches	• B = 68	None
20.	Brush-tailed Rabbit-rat targeted survey (Firth 2003)	April 2003	Systematic - targeted survey using quadrats	• M = 1	None
21.	ERA Birdwatch Events 2001	Field survey 2001	Opportunistic searches	• B = 41	<ul style="list-style-type: none"> <li>• Rainbow Bee-eater (Mi)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> </ul>

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
22.	A whole-ecosystem approach to Environmental monitoring: Ranger mine case study (Corbett 2000)	Field survey 1994 - 1998 (Microbats Nov 1997 only)	Systematic - Quadrats and transects, pit-traps, Elliot and cage traps, bird census, diurnal and nocturnal opportunistic searches and recordings of microbats using AnaBat II	<ul style="list-style-type: none"> <li>• F = 15</li> <li>• R = 35</li> <li>• B = 115</li> <li>• M = 16</li> </ul>	<ul style="list-style-type: none"> <li>• Northern Quoll (CR EN, TPWCA; VU, EPBC)</li> <li>• Common Greenshank (CAMBA; JAMBA; ROKAMBA)</li> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• Curlew Sandpiper (CAMBA; JAMBA; ROKAMBA; Bonn)</li> <li>• Marsh Sandpiper (CAMBA; JAMBA; ROKAMBA)</li> <li>• Cattle Egret (CAMBA; JAMBA)</li> <li>• Rainbow Bee-eater (Mi)</li> <li>• White-bellied Sea-Eagle (CAMBA)</li> </ul>
23.	Fauna at Ranger Mine waste rock dumps: Colonisation of experimental revegetation plots and persistence of populations (Corbett 1999)	Field surveys Nov 1996 - Oct 1998	Systematic - pit-traps, Elliott & cage traps, bird census, diurnal and nocturnal opportunistic searches	<ul style="list-style-type: none"> <li>• IN = 23</li> <li>• F = 16</li> <li>• R = 16</li> <li>• B = 41</li> <li>• M = 16</li> </ul>	<ul style="list-style-type: none"> <li>• Northern Quoll (CR EN, TPWCA; EN, EPBC)</li> </ul>
24.	Results of baseline surveys of Bat fauna of the Jabiluka and Ranger mining leases, Northern Territory (Richards 1998)	Field survey conducted Sep 1998 & Nov 1997	Systematic - Recordings of microbats using AnaBat II	<ul style="list-style-type: none"> <li>• M = 17</li> </ul>	None
25.	The role of ants in minesite restoration in the Kakadu region of Australia's Northern Territory, with particular reference to	Field survey 1993/94	Systematic - transects, pit-traps, opportunistic collections	<ul style="list-style-type: none"> <li>• A = 162</li> <li>• IN = 424</li> </ul>	N/A

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
	their use as bi indicators (Anderson <i>et al.</i> 1998)				
26.	Waterbird Richness and Abundance at Ranger Waterbodies 1994-97 (Corbett & Sewell 1997)	Field survey Oct 94 – Dec 97	Systematic – bird census	<ul style="list-style-type: none"> <li>• B = 48</li> <li>• B = #15</li> </ul>	<ul style="list-style-type: none"> <li>• Cattle Egret (CAMBA; JAMBA)</li> <li>• Curlew Sandpiper (CAMBA; JAMBA; ROKAMBA; Bonn)</li> <li>• Pacific Golden Plover (JAMBA; ROKAMBA; Bonn)</li> <li>• Red-kneed Dotterel (Bonn)</li> <li>• Black-fronted Dotterel (Bonn)</li> <li>• Red-capped Plover (Bonn)</li> <li>• Masked Lapwing (Bonn)</li> <li>• Marsh Sandpiper (CAMBA; JAMBA; ROKAMBA; Bonn)</li> <li>• Whimbrel (JAMBA; CAMBA; ROKAMBA; Bonn)</li> <li>• Common Sandpiper (CAMBA; JAMBA; ROKAMBA; Bonn)</li> <li>• Common Greenshank (CAMBA; JAMBA; ROKAMBA; Bonn)</li> <li>• Pacific Black Duck (Bonn)</li> <li>• Grey Teal (Bonn)</li> <li>• Hardhead (Bonn)</li> <li>• Green Pygmy Goose (Bonn)</li> <li>• Caspian Tern (JAMBA; CAMBA)</li> <li>• Black-winged Stilt (Bonn)</li> <li>• Great Egret (JAMBA; CAMBA)</li> <li>• Pink-eared Duck (Bonn)</li> <li>• Plumed Whistling-Duck (Bonn)</li> <li>• Wandering Whistling-Duck (Bonn)</li> </ul>

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
					<ul style="list-style-type: none"> <li>• Magpie Goose (Bonn)</li> <li>• Radjah Shelduck (Bonn)</li> <li>• Glossy Ibis (CAMBA; Bonn)</li> <li>• #Black-tailed Godwit (VU, ROKAMBA; CAMBA; JAMBA)</li> <li>• #Red-necked Stint (ROKAMBA; CAMBA; JAMBA)</li> <li>• #Grey Plover (ROKAMBA; CAMBA; JAMBA)</li> </ul>
					<ul style="list-style-type: none"> <li>• #Wood Sandpiper (ROKAMBA; CAMBA; JAMBA)</li> <li>• #Long-toed Stint (CAMBA; JAMBA)</li> <li>• #Grey-tailed Tattler (ROKAMBA; CAMBA)</li> <li>• #Lesser Sand Plover (ROKAMBA; CAMBA; JAMBA)</li> <li>• #White-winged Tern (CAMBA; JAMBA)</li> <li>• #Greater Sand Plover (ROKAMBA; CAMBA; JAMBA)</li> <li>• #Little Ringed Plover (ROKAMBA; CAMBA)</li> <li>• #Terek Sandpiper (ROKAMBA; CAMBA; JAMBA)</li> <li>• #Broad-billed Sandpiper (ROKAMBA; CAMBA; JAMBA)</li> <li>• #Ruddy Turnstone (ROKAMBA; CAMBA; JAMBA)</li> <li>• #Swinhoe's Snipe (ROKAMBA; JAMBA)</li> </ul>

### 3.3 AQUATIC FLORA AND FAUNA

A total of three documents that include aquatic flora and fauna survey work that has been undertaken on the RPA have been reviewed and summarised below in chronological order from most recent to oldest (Table 3). Literature from scientific journals was used and referenced but not placed in the table because it does not specifically relate to surveys on the RPA. The summary table includes information on various aspects of the survey/monitoring programme such as the methodologies employed, number of species and whether or not conservation significant, or introduced species, were recorded. Some of the aquatic surveys did occur in billabongs that are not on the RPA; however data is only presented for the RPA.

Table 3. Summary of aquatic flora and fauna surveys for the Ranger Project Area.

Fauna species codes: P = Phytoplankton, Z = Zooplankton, MI= Microinvertebrates (predominantly Zooplankton), MA = Macroinvertebrates, F = Fish, and, AV = Aquatic vegetation.

No	Survey	Desktop or Field Survey	Methods	Total No. Species	Conservation Significant Species Recorded
1.	Aquatic Fauna Assessments 2009. Creeks and Billabongs Downstream of Ranger Uranium Mine. (WRM 2010)	Field survey April/May 2009	Systematic – Exposed versus reference	<ul style="list-style-type: none"> <li>• P (creekline) = 158</li> <li>• P (billabongs) = 170</li> <li>• Z (creekline) = 195</li> <li>• Z (billabongs) = 228</li> <li>• MI (creeklines) = 212</li> <li>• MI (billabongs) = 147</li> <li>• F (billabongs) = 14</li> <li>• F (creeklines) = 12</li> </ul>	<ul style="list-style-type: none"> <li>• Z= six new species and five new records for Australia</li> <li>• P= <i>Coelosphaerium kuetzingianum</i> (potentially toxic species)</li> </ul>
2.	Aquatic Studies at Ranger Mine: Whole-Ecosystem Monitoring – Round 2 (Corbett <i>et al.</i> 2004)	Field survey May/June 2001.	Systematic – Transects and opportunist sampling	<ul style="list-style-type: none"> <li>• AV = 41</li> <li>• MI = 44</li> <li>• MA = 11</li> <li>• F = 22</li> </ul>	<ul style="list-style-type: none"> <li>• MI = <i>Alona archeri</i> (first record for the NT)</li> </ul>
3.	A whole-ecosystem approach to Environmental monitoring: Ranger mine case study (Corbett 2000)	Field survey April/May 1995	Systematic – Transects and opportunistic sampling	<ul style="list-style-type: none"> <li>AV = 40</li> <li>MI = 60</li> <li>MA = 72</li> <li>F = 19</li> </ul>	None

\*Due to the layout of the data it was too difficult to distinguish between sites on the RPA and those not on the RPA.

### 3.4 PAST LITERATURE REVIEWS

There have been several past literature and desk top reviews of flora and fauna surveys (and relevant data bases) that have been undertaken on the RPA. Of these, six have examined flora surveys or information related to vegetation and habitats, five have assessed fauna surveys and other various aspects such as introduced fauna and two have examined aquatic vegetation, macro and micro invertebrates and vertebrate fauna (Table 4). The only review to identify any species of conservation significance listed under the EPBC Act that has been recorded on the RPA in the past was Brady *et al.* (2007). They identified the Northern Quoll and Partridge Pigeon.

Table 4. Past literature and desk top reviews of flora and fauna surveys for the Ranger Project Area. Please note that some of the documents do not specifically focus on the RPA, but do include reviews of the flora and fauna or document vegetation on the RPA.

Document	
1.	Review of Flora surveys in the area of the proposed Heap Leach Facility (Gellert 2011).
2.	Environmental risk associated with vegetation disturbance on the Ranger and Jabiluka Mineral Lease (Brady <i>et al.</i> 2007).
3.	Environmental monitoring at Ranger Mine: A whole-ecosystem Approach (Corbett 2006).
4.	Ecosystem reconstruction for the Ranger mine Final landform – Phase 1 Target Habitats (Hollingsworth <i>et al.</i> 2003).
5.	Description and literature review of the flora and vertebrate fauna of Magela Creek, Alligator Rivers Region, northern Australia (Gardner <i>et al.</i> 2002).
6.	Vegetation Habitats Kakadu National Park, Alligator Rivers Region, Northern Territory (Schodde <i>et al.</i> 1987).
7.	ERA Fauna Management Plan (Hooke 2008).

## 4 SIGNIFICANT RESULTS OF PAST SURVEYS

### 4.1 TERRESTRIAL FLORA

There has been a substantial survey and monitoring effort undertaken across the RPA over the last 10-15 years (18 documents) of the terrestrial flora. Significantly, no species of conservation significance listed under the TPWC Act and / or the EPBC Act has been recorded during these surveys (Table 1). All of the species recorded are common and widespread on the RPA and in the Top End.

### 4.2 TERRESTRIAL FAUNA

From the literature a number of conservation significant species have been recorded on the RPA during previous surveys (Table 2). The two most notable of these are listed under both the EPBC Act and TPWC Act (Northern Quoll and Partridge Pigeon) and they are briefly discussed below.

The habitat in the area demarcated for the surface vent raise infrastructure and surrounding it, is for the most part eucalypt woodland and open forest (Figures 2 & 3) that has been disturbed as a result of past activities associated with dry season irrigation and exploration. These eucalypt woodlands and open forests are the most widespread habitats on the RPA. Further to this the RPA is surrounded by the same expansive and primarily undeveloped tracts of the same eucalypt woodlands and open forest savannas that cover at least 180,000 km<sup>2</sup> in the NT alone (Woinarski *et al.* 2005).

The Endangered Northern Quoll has been recorded during three separate surveys (Corbett *et al.* 2004; Corbett 2000; Corbett 1999) (Table 2). They once occurred commonly in rocky escarpment and eucalypt woodlands across the Top-End of the NT (Begg 1981; Oakwood 2002), but have undergone widespread and dramatic declines as a result of poisoning after ingesting the toxic and introduced Cane Toad (*Chaunus marinus*) that has spread across the Top End (Oakwood 2004; Rankmore *et al.* 2008; Woinarski *et al.* 2010). Several comprehensive surveys have been undertaken on the RPA post-Cane Toad invasion (~2003) but no Northern Quolls have been recorded suggesting that the local population has been severely impacted by the toad or made locally extinct (Table 2). The Cane Toad has been recorded on the RPA during several surveys and is regarded as abundant, particularly in and about areas with water (annual or permanent water bodies) (Firth 2008a, b; Smith 2009; Firth 2010a; Firth & Davey 2011).

The Vulnerable Partridge Pigeon has been recorded on the RPA in eucalypt woodlands many times during systematic surveys and during ERA Birdwatch events (Table 2). The Partridge Pigeon occurs in lowland eucalypt woodland and open forest of the northern Australia savanna (Fraser and Whitehead 2005). These birds are known to move up to 2 km to drink and have home ranges of 8 ha on average (Fraser *et al.* 2003). The Partridge Pigeon has declined noticeably in some regions of northern Australia, possibly due to feral predators, changed fire regimes, grazing and exotic grasses (Woinarski *et al.* 2007). The Partridge Pigeon is still

abundant throughout areas of Kakadu, Litchfield National Park (Woinarski *et al.* 2007), the Tiwi Islands (Woinarski *et al.* 2003) and the RPA (Firth 2008a, b; Smith 2008; Firth 2010a).

Many birds listed under the various migratory agreements (CAMBA, JAMBA, ROKAMBA and as migratory under the EPBC Act) have been recorded on the RPA (Table 2). However seasonally these species are widespread and common throughout Kakadu (and much of continental Australia with suitable habitat), as a consequence of the extensive wetlands that occur in the Park (Director of National Parks 2007).

#### 4.3 AQUATIC FLORA AND FAUNA

One of the most comprehensive aquatic surveys was undertaken in 2009 on the RPA (WRM 2010) (Table 3). During this survey six of the zooplankton taxa were collected from creek lines and are probably undescribed species. A further five zooplankton species were previously unknown to occur in Australia. The conservation significance of these species is unknown. No listed or endangered macroinvertebrate or fish species were recorded during the study (WRM 2010).

One potentially toxic phytoplankton species, the cyanophyte *Coelosphaerium kuetzingianum*, was recorded from Coonjimba, RP1 and Gulungul billabongs and from Corridor Creek immediately downstream of "Sleepy Cod" billabong. However, there were no obvious correlations with spot measurements of water quality data to suggest the presence of this phytoplankton species was related to nutrient enrichment or mine run-off (WRM 2010).

## 5 THE BIOLOGICAL ENVIRONMENT AND KEY CONSIDERATIONS

In the objectives section under Phase 1, point (a) seeks to determine if the previous surveys and data are sufficient to address consideration of potential impacts on the flora and fauna as a result of the proposed work associated with the vent raise. A number of these key considerations are discussed below.

*Describe the habitats, communities and animal/plant species within them, noting significance of the biological diversity (as per the Convention on Biological Diversity), and current condition.*

The habitats and the flora and fauna species within them have been documented for the RPA as a result of a series of surveys and reviews (e.g. Schodde *et al.* 1987; Brady *et al.* 2007; Firth 2010; WRM 2010) (Tables 1 – 3). The two most notable vertebrate fauna species are the Northern Quoll and Partridge Pigeon, which are both listed on EPBC Act and TPWC Act. The former species appears to be declining in the Top End, including the RPA, because of the impact of Cane Toads. The biological diversity of the RPA is a subset (from a much less extensive area) of the biological diversity in similar habitats of Kakadu (Geering *et al.* 2007). The vertebrate fauna and plant communities outside the direct mine footprint are currently in good to excellent condition.

The area proposed to be disturbed as a consequence of infrastructure associated with the vent raise, has had a history of disturbance, from the application of pond water that resulted in the clearing of vegetation for pipes and associated access tracks to more recent exploration activity, which resulted in the clearing of vegetation for tracks and drill pads (Figure 5).



Figure 5: Photo of part of the area where the proposed vent raise will be located. Note the tracks and drill pads in the foreground that are associated with recent R3 Deeps exploration activity.

The habitats of the proposed area to be disturbed consist of eucalypt woodland and open forest that are principally co-dominated by *Eucalyptus miniata* and/or *E. tetradonta*. These eucalypt woodlands and open forest savannas dominate the region and cover at least 180,000 km<sup>2</sup> in the NT alone.

The only threatened species that is likely to occur in the area proposed for the vent raise and associated infrastructure is the Partridge Pigeon, as this species has a preference for eucalypt woodland and open forest and is the only EPBC Act threatened species to have been recorded on the RPA in the recent past (Firth and Davey 2011).

*Ecological relationships, including the conservation status of species or associations to be disturbed by the new development (including species and communities listed under the EPBC Act).*

Given the small size of the proposed footprints associated with the surface vent raises and associated infrastructure, there will be very little disturbance to flora and fauna species, or to conservation significant species listed under the EPBC Act.

*Other sensitive environments or areas of special significance (breeding sites, seasonal habitats, wetlands, etc.) in the footprint of the new development and potentially affected by the proposed activity (downstream, down-wind, etc.).*

There are no sensitive environments (significant breeding sites, seasonal habitats or wetlands areas or RAMSAR sites) of special significance in the area in which infrastructure associated with the ventilation system may be located.

*Introduced flora and fauna.*

Flora - ERA describes its activities to manage and control weed (introduced plant) infested areas on the RPA in a 5 year Weed Management Plan (ERA 2011). In 2002 it was decided that annual mapping was an essential method to successfully manage weeds. Consequently fine scale annual weed mapping has been undertaken on the RPA since 2003 to detect any long-term changes in the abundance and distribution of weeds (Gellert and McIntyre 2011). Over this period 44 weed species have been recorded on the RPA (Gellert and McIntyre 2011). For comparison 99 weed species have been recorded in Kakadu National Park (Brennan 1996).

Fauna - ERA account for its activities to manage and control introduced fauna on the RPA in a Fauna Management Plan (Hooke 2008). On the RPA a total of eight introduced vertebrate fauna (most of which are highly mobile) and two introduced invertebrate species have been recorded (Hooke 2008). For comparison 11 introduced fauna vertebrate species have been recorded in Kakadu (Press *et al.* 1995), including the Cane Toad which is now distributed across the Park. There are a number of introduced invertebrates (at least eight) recorded in Kakadu (Director of National Parks 2007).

*The extent to which the environment is already affected by existing mining (and exploration) activities.*

The main impact associated with existing mining activities on the RPA has been the clearing or disturbance of approximately 2,270 ha of native vegetation. The level of disturbance and clearing of native vegetation in some areas is negligible to none, particularly in the south-east, south-west and west areas of the RPA. The location of vent raise and associated surface infrastructure will be relatively localised within the vicinity of the MLAA which has now been decommissioned. This area has also been disturbed to a considerable extent as a consequence of recent exploration activity, the presence of weeds and a hot fire that burnt much of the area in 2008 (Addison 2011).

## 6 SUMMARY

This report has synthesized a total of 18 documents that have reported on flora survey work, 26 reports that have presented results of fauna surveys, three reports that have documented aquatic flora and fauna survey work and seven documents that reviewed previous terrestrial and aquatic flora and fauna work.

Due to the very limited size of the proposed area of disturbance for ventilation infrastructure and its location in the already heavily disturbed MLAA, impacts to terrestrial flora and vertebrate fauna associated with the proposed underground mine infrastructure would be insignificant in a local and a regional context. Furthermore, given that the vent raises will be restricted to within the MLAA, away from the Magela Creek it is very unlikely that there would be any significant impacts to aquatic flora and fauna associated with the Magela Creek.

More importantly, no flora species of conservation significance listed under the TPWC Act and / or the EPBC Act has been recorded on the RPA; therefore, the little impact that will occur as a result of the clearing of vegetation for the vent raises will only affect species that are common and widespread across the Top End. The only EPBC Act listed fauna species (Partridge Pigeon) still known with certainty to occur on the RPA, is a mobile species and will therefore be unaffected by the clearing of such small areas of vegetation.

Many birds listed under the various migratory agreements (CAMBA, JAMBA, ROKAMBA) have been recorded on the RPA; however, seasonally these species are widespread and common throughout Kakadu (and much of continental Australia with suitable habitat), as a consequence of the extensive wetlands that occur in the Kakadu (Director of National Parks 2007). In addition, these species are highly mobile and the habitats that occur in the proposed area of disturbance (eucalypt woodland and open forest) are not habitats typically associated with most of the species listed under the migratory agreements. Consequently there will be no impact to populations of these species on the RPA or more broadly to populations in the region.

## STATEMENT OF LIMITATIONS

### Scope of Services

This literature review (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV Australia Pty Ltd (ENV) (“scope of services”). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

### Reliance on Data

In preparing the report, ENV has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report (“the data”). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (“conclusions”) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to ENV.

### Environmental Conclusions

In accordance with the scope of services, ENV has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

### Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to: any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

## Other Limitations

ENV will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

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