



Chapter 14
Matters of national environmental
significance

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14 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

14.1 INTRODUCTION

This chapter assesses the risks presented to matters of national environmental significance (MNES) by the Project. Also described are the existing controls and additional treatments that ERA will implement through project design, construction, operations and decommissioning to mitigate impacts on these values.

The chapter is based on the findings of several assessments:

- Vegetation and fauna assessment by Eco Logical Australia (**Chapter 9** and **Appendix 12**).
- Social impact assessment by Banarra (**Chapter 11** and **Appendix 14**)
- Transportation impact assessment by GHD Pty Ltd (**Chapter 12** and **Appendix 16**).
- Air quality assessment by Pacific Environment Limited (**Chapter 6** and **Appendix 6**).
- Noise and vibration impact assessment by SLR Pty Ltd (**Chapter 6** and **Appendix 7**).
- Assessment of potential impacts to surface and groundwater presented in **Chapter 8** and **Appendix 10**.
- Assessment of potential impacts to cultural heritage presented in **Chapter 10**.

Specifically, this chapter discusses:

- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral (**Section 14.2**).
- Protected matters search (**Section 14.3**).
- Approach to assessment of MNES (**Section 14.4**).
- Listed threatened species and communities (**Section 14.5**).
- Listed migratory species (**Section 14.6**).
- World heritage properties (**Section 14.7**).
- National heritage places (**Section 14.8**).
- Wetlands of international importance (**Section 14.9**).
- Commonwealth land (**Section 14.10**).
- Nuclear actions (**Section 14.11**).

Chapter 2 describes the existing ecological, amenity, cultural heritage and water values within the study and broader area and includes MNES. Impacts and risks to amenity (air quality, noise and vibration), water, flora and fauna, and cultural heritage, which include MNES, are addressed in **Chapters 6, 8, 9 and 10**, respectively. Social risks are described in **Chapter 11**, while risks associated with transport are discussed in **Chapter 12** and closure risks in **Chapter 13**.

14.2 EPBC ACT REFERRAL

The EIS guidelines require an assessment of matters that are protected under Part 3 of the EPBC Act. This includes MNES and other matters protected under the act, i.e. the environment on Commonwealth land that may be impacted by an action.

The Project was referred to the Commonwealth Minister for the Environment (formerly Minister for Sustainability, Environment, Water, Population and Communities) in January 2013 and was subsequently determined to be a controlled action requiring assessment and approval under the EPBC Act. The relevant controlling provisions are:

- World heritage properties (sections 12 and 15A).
- National heritage places (sections 15B and 15C).
- Wetlands of international Importance (sections 16 and 17B).
- Listed threatened species and communities (sections 18 and 18B).
- Listed migratory species (sections 20 and 20A).
- Nuclear action (sections 21 and 22A).
- Commonwealth land (sections 26 and 27).

14.3 PROTECTED MATTERS SEARCH

14.3.1 Search Results

A Commonwealth Department of the Environment protected matters search was undertaken in July 2012 to assist with preparation of the Project referral. The results were used to provide guidance on MNES and other matters protected by the act that may occur within the Project area. The search was repeated in January 2014 to ensure currency of the findings, and addressed the same area around the current Ranger mine (which followed the western, southern and eastern boundary of the RPA and included a 1 km buffer, shown in **Figure 14-1**). The outcomes of the protected matters search, relevant to the controlling provisions of the Project, are presented in **Table 14-1**.



Figure 14-1: Protected matters search area

Table 14-1: Summary of protected matters

Protected matter	Number	Comment
World heritage properties	1	Kakadu National Park, which surrounds the Ranger Project Area within which the Ranger mine is located.
National heritage places	1	Kakadu National Park, which surrounds the Ranger Project Area within which the Ranger mine is located.
Wetlands of international significance	2	Kakadu (stage 1 and 3) Kakadu (stage 2) The Ranger mine is located within the catchment areas of these two Ramsar wetlands.
Listed threatened ecological communities	1	Arnhem Plateau sandstone shrubland complex
Listed threatened species	16 ¹	1 ¹ flora species. 14 fauna species. 1 estuarine/marine species.

Protected matter	Number	Comment
Listed migratory species	19	18 avian migratory species. 1 non-avian migratory species.
Commonwealth land	2	Kakadu National Park, which surrounds the RPA within which the Ranger mine is located. Commonwealth land (not specified).

1. The protected matters search report also included *Sauropus filicinus* (a shrub) which was delisted from the EPBC Act on 14 December 2013 (Department of the Environment 2014a) and hence has been excluded from the assessment presented in this chapter.

An additional protected matters search was undertaken for the transportation study to identify listed threatened and migratory species that may be located along Project transport routes. These search results are reported separately in **Section 12.5.1.2**.

14.3.2 Potential for Impact on MNES

The protected matters search was undertaken for a broad area that encompassed the footprint of the current Ranger mine. As outlined in **Chapter 3**, virtually all above ground infrastructure will be installed within the current operating area. The only surface disturbance required for the Project that is located beyond the current operating area will be associated with construction of Intake 1 and Exhaust 4¹ ventilation shafts, which includes minor (<1 ha) vegetation clearance and the movement of heavy equipment and vehicles associated with infrastructure construction. Other disturbances include noise from operation of surface-based fans and localised deposition of dust or other airborne contaminants from the ventilation shafts. Therefore, the potential area of direct impact on threatened and migratory species and ecological communities can be restricted to areas near the ventilation shafts along the eastern boundary of Pit 3 and within the boundary shown on **Figure 3-16** labelled "Maximum extent of infrastructure".

14.3.3 MNES that Require Further Assessment

Not all MNES identified in the protected matters search as potentially occurring within the Project area require assessment.

The vegetation and fauna study provides an assessment of the likelihood of nationally listed flora species and communities potentially occurring within the areas that will be directly impacted by the Project (**Appendix 12** and **Table 14-2**). The assessment was based on the protected matters search, literature reviews, surveys (for the Project and previously for the Ranger mine), threatened species fact sheets and other information published by the Commonwealth Department of the Environment and the NT Department of Land Resource Management.

¹ Note: Exhaust 3b will be within an existing area of disturbance associated with the construction of Exhaust 3A for the exploration decline project.

Table 14-2: EPBC Act listed flora species and ecological communities

Name	EPBC Act status	Likelihood of occurrence ¹	Distance of species/community to Project (km ²)
Arnhem Plateau Sandstone Shrubland Complex	Threatened ecological community	Highly unlikely	4
<i>Acacia</i> sp. Graveside Gorge	Critically endangered species	Highly unlikely	77
<i>Hibiscus brennanii</i>	Vulnerable species	Highly unlikely	9

1. Highly unlikely = Habitat on and in the vicinity of the Project site is highly unsuitable for the species. Based on the known habitat requirements of the species, the Project site lacks the required habitat.

2. Distance has been recorded to the nearest whole km.

None of the species, nor the ecological community, listed in **Table 14-2**, i.e. MNES, were identified during the Project, or any previous, flora survey; therefore, no further assessment of listed threatened flora species or ecological communities has been undertaken in **Section 14.5** of this chapter.

A similar assessment was undertaken for the likelihood of nationally listed fauna and migratory species occurring within areas that will be impacted by the Project (**Table 14-3**).

Table 14-3: EPBC Act listed fauna species

Name	EPBC Act status	TPWC Act status	Likelihood of occurrence ¹
Birds			
Eastern partridge pigeon <i>Geophaps smithii smithii</i>	Vulnerable	Vulnerable	Known
Northern masked owl <i>Tyto novaehollandiae kimberli</i>	Vulnerable	Vulnerable	Likely
Red goshawk <i>Erythrotriorchis radiatus</i>	Vulnerable	Vulnerable	Likely
Yellow chat <i>Epthianura crocea tunneyi</i>	Endangered	Endangered	Unlikely (but requires assessment under the EIS guidelines)
Mammals			
Arnhem land rock rat <i>Zyomys maini</i>	Vulnerable	Vulnerable	Unlikely
Bare-rumped sheath-tailed bat <i>Saccolaimus saccolaimus nudicluniatus</i>	Critically endangered	Not listed	Likely
Brush-tailed rabbit rat <i>Conilurus penicillatus</i>	Vulnerable	Endangered	Possible (formerly known)
Golden-backed tree rat <i>Mesembriomys macrurus</i>	Vulnerable	Critically endangered	Possible
Northern brush-tailed phascogale <i>Phascogale pirate</i>	Vulnerable	Endangered	Possible

Name	EPBC Act status	TPWC Act status	Likelihood of occurrence ¹
Northern quoll <i>Dasyurus hallucatus</i>	Endangered	Critically endangered	Possible (formerly known, however EIS guidelines require assessment)
Reptiles			
Arnhem land egernia <i>Bellatorias obiri</i>	Endangered	Endangered	Unlikely
Plains death adder <i>Acanthophsis hawkei</i>	Vulnerable	Vulnerable	Highly unlikely (but requires assessment under the EIS guidelines)
Migratory birds			
Barn swallow <i>Hirundo rustica</i>	Migratory	Not listed	Possible
Cattle egret <i>Ardea ibis</i>	Migratory	Not listed	Known
Common sandpiper <i>Actitis hypoleucos</i>	Migratory	Not listed	Known (but not recorded in 2014 survey)
Derby white-browed robin <i>Poecilodryas superciliosa cerviniventris</i>	Migratory	Not listed	Likely
Eastern great egret <i>Ardea modesta</i>	Migratory	Not listed	Known
Gouldian finch <i>Erythrura gouldiae</i>	Endangered, migratory	Vulnerable	Possible
Grey plover <i>Pluvialis squatarola</i>	Migratory	Not listed	Possible (but requires assessment under the EIS guidelines)
Marsh sandpiper <i>Tringa stagnatilis</i>	Migratory	Not listed	Known (but not recorded in 2014 survey)
Melville cicadabird <i>Coracina tenuirostris melvillensis</i>	Migratory	Not listed	Likely
Oriental plover <i>Charadrius veredus</i>	Migratory	Not listed	Likely
Oriental pratincole <i>Glareola maldivarum</i>	Migratory	Not listed	Likely
Rainbow bee-eater <i>Merops ornatus</i>	Migratory	Not listed	Known
Rufous fantail <i>Rhipidura rufifrons</i>	Migratory	Not listed	Likely
Terek sandpiper <i>Xenus cinereus</i>	Migratory	Not listed	Likely
Whimbrel <i>Numenius phaeopus</i>	Migratory	Not listed	Known (but not recorded in 2014 survey)
White-bellied sea-eagle <i>Haliaeetus leucogaster</i>	Migratory	Not listed	Known

Name	EPBC Act status	TPWC Act status	Likelihood of occurrence ¹
Migratory reptiles			
Saltwater crocodile <i>Crocodylus porosus</i>	Migratory	Not listed	Known
Fish			
Largetooth sawfish <i>Pristis pristis</i>	Vulnerable	Vulnerable	Highly unlikely (but requires assessment under the EIS guidelines)
Dwarf sawfish <i>Pristis clavata</i>	Vulnerable	Vulnerable	Highly unlikely (but requires assessment under the EIS guidelines)
Northern river shark <i>Glyphis garricki</i>	Endangered	Endangered	Highly unlikely (but requires assessment under the EIS guidelines)
Speartooth shark <i>Glyphis glyhis</i>	Critically endangered	Vulnerable	Highly unlikely (but requires assessment under the EIS guidelines)

1. Likelihood definitions:

Known = Species has been recorded within the project area within the last decade.

Likely = Medium to high probability that a species uses the site. The species has been recorded within the local area and habitat within the site is considered to be highly suitable.

Possible = Medium to low probability that a species used the site. The species has been recorded within the local area or region and habitat within the site is considered to be moderately suitable.

Unlikely = Very low to low probability that a species uses the site. The species may or may not occur locally or regionally, however based on the known habitat requirements of the species, and habitat available within the site, the site is considered unlikely to be suitable or marginal at best.

Highly unlikely = Habitat on site and in the vicinity is highly unsuitable for the species. Based on the known habitat requirements of the species, the site lacks the required habitat.

The locations of the six nationally listed fauna species that were recorded during the flora and fauna survey are shown in **Figure 9-6**.² Eight nationally listed migratory bird species were recorded during the survey. These species that are known to occur, those species considered likely to occur within or near the Project area, and those specifically identified in the EIS guidelines as requiring assessment (23 species in total) are shaded in **Table 14.3** and were the subject of a detailed assessment presented in **Sections 9.4.1** and **9.4.2** and summarised in **Section 14.5** and **Section 14.6** below.

² NT protected species that are not nationally listed species are also shown in the figure.

The protected matters search identified two areas of Commonwealth land: Kakadu National Park (the Park) and an area that was not specified). As no details are provided on the unspecified Commonwealth land (not specified), which is a function of the databases used to generate the protected matters search report, assessment of this land portion is not possible. However the assessment incorporates of all areas surrounding the RPA.

14.4 APPROACH TO ASSESSMENT OF IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

14.4.1 Risk Assessment

Chapter 5 describes how the assessment of environmental risks, which included potential impacts to matters of MNES, was undertaken (**Section 5.4**). The social impact assessment (SIA) undertaken for the Project also identified risks to MNES in terms of impacts to Aboriginal cultural values and activities, and natural and cultural heritage (**Section 11.2.6**). Similarly, the traffic impact assessment investigated the Project's traffic profile on MNES or, more specifically, listed threatened and migratory species and environmental values (including world heritage and national heritage values) (**Section 12.2.3**). Potential impacts (consequences) of each Project risk were identified and assessed by applying likelihood and severity of consequence ratings that, combined, generated a risk rating.

A total of 80 risks were identified in the environmental risk assessment for the Project. Of these, 34 were identified as having an inherent risk rating of Class III (32) or Class IV (2). The final residual risk profile, that reflects the implementation of additional treatments, indicates 19 Class III risks and no Class IV risks (refer **Section 5.3**). Class III and IV risks relating to MNES are discussed in the relevant risk chapter (refer **Chapters 6, 8, 9, 10 and 12**).

The SIA identified a total of 51 risks. Of these, 13 relate to MNES and have a low residual risk ranking. Each of these risks is discussed in **Appendix 14**.

The traffic impact assessment identified 14 hazards³ associated with the transport of 14 different consumables/materials. Four hazards resulted in a residual Class IV, and two hazards a residual Class III, risk rating. None of the Class IV risks related to MNES. The Class III risks relate to potential impacts on listed threatened and migratory species and environmental values, and these are discussed in **Chapter 12 and Appendix 16**.

14.4.2 Threatened Species, International Wetlands, Listed Properties and Places

Impacts to MNES have been assessed in accordance with Commonwealth guidelines (DEWHA 2013). A significant impact is defined by the guidelines as an impact which is

³ Transport hazards were broken down into three events (risk scenarios) at a number of environmentally sensitive locations, resulting in more than one risk per hazard, e.g. the risk of a vehicle incident leading to a loss of containment was assessed at each sensitive location for each consumable. In this case, one hazard could generate three events at each of 14 different locations, but this does not represent 42 different events (risk scenarios). The risks all stem from the one hazard, i.e. the transport of a consumable.

important, notable or of consequence, having regard to its context or intensity. This depends on the sensitivity, value and quality of the environment that is impacted and upon the duration, magnitude and geographic extent of the impact. To determine the nature and magnitude of the impact on MNES, the following were considered:

- sensitivity of the environment impacted;
- timing, duration and frequency of the proposed action and its impacts;
- on-site and off-site impacts;
- direct and indirect impacts;
- total impact that can be attributed to the action over the entire geographic area affected and over time;
- existing levels of impact from other sources; and
- degree of confidence with which the impacts are known and understood.

Project impacts on MNES are assessed against the criteria that are described in the guidelines relating to listed threatened and migratory species, wetlands of international importance, world heritage properties and national heritage places.

14.4.3 Commonwealth Land

Impacts to the environment on Commonwealth land are assessed against Commonwealth guidelines (SEWPaC 2013). The assessment considers:

- the context of the environment within which the Project is located;
- potential impacts likely to be generated by the Project;
- whether mitigation measures will avoid or reduce these impacts; and
- whether the impacts are likely to be significant;

As with the MNES guidance, the assessment of impacts to Commonwealth land considers:

- nature of impacts, e.g. adverse or beneficial;
- indirect and off-site impacts;
- severity of potential impacts including scale, intensity, timing, duration and frequency; and
- uncertainty about potential impacts.

These impacts are assessed for, where relevant, landscapes and soils, coastal landscapes and processes, water resources, chemicals and toxic substances, plants, animals, people and communities, and heritage.

14.4.4 Nuclear Actions

The EPBC Act defines mining and milling uranium ore as a nuclear action. This Draft EIS addresses the potential impacts associated with extracting, processing and transporting uranium material. SEWPaC (2013) does not provide criteria to assess whether the environment is protected from a nuclear action or whether the action will have significant impact on the environment. Therefore, the assessment of impacts is addressed by, in particular, the risk chapters, i.e. **Chapters 6 to 13**.

14.5 ASSESSMENT OF IMPACTS TO THREATENED SPECIES

Information in **Section 14.5** is drawn from **Appendix 12** unless stated otherwise.

14.5.1 Studies and Surveys

There have been 26 studies of terrestrial fauna, including targeted surveys and monitoring programs undertaken, on the RPA and, in some case, including including parts of Kakadu National Park between 1994 and 2011. These surveys were undertaken throughout the year and employed a variety of methods.

A survey specifically for the Project was conducted over eight days between 4 and 11 September 2013, within the Magela land application area (LAA) and surrounding area. This survey used a combination of techniques, considering the Department of the Environment guidelines for the survey of Australian threatened fauna, to target species (refer **Section 9.2.2**).

The assessment of listed threatened species along the transportation routes is described in **Section 12.5.1** and **Appendix 16** and involved a combination of desktop assessment (including a protected matters search) and site inspections. Threatened flora and fauna abundance within 5 km on each side of the transportation routes has been identified in **Appendix 8**.

14.5.2 Potential Impact Associated with the Project

The proposed Project will develop an underground resource that will be supported by new surface infrastructure located within the Ranger mine's operational area. This will be within the existing mine disturbance footprint, with the exception of a small area associated with ventilation shafts that will be constructed within and adjacent to the Magela LAA. In total, <1 ha of already disturbed vegetation will be cleared to accommodate the ventilation shafts. Air and noise emissions will be generated during Project construction and operations which could potentially impact vegetation and fauna surrounding (predominantly to the north and east of) Pit 3, the fuel pad, heavy vehicle parking and office complex for the Project (refer **Figure 3-16**).

Under normal operating conditions, transportation activities are not expected to impact vegetation and fauna (apart from road kill). However, risk events are associated with transportation, e.g. a vehicle incident involving loss of containment.

14.5.3 Mitigation Measures

The Ranger Environmental Requirements that are prescribed in the section 41 Authority set out the environmental protection conditions with which ERA must comply; these are the environmental objectives for the Ranger mine. The primary environmental protection objectives defined under the environmental requirements that relate to MNES are:

- Maintain the attributes for which Kakadu National Park was inscribed on the World Heritage List.
- Maintain the ecosystem health of the wetlands listed under the Ramsar Convention on wetlands (i.e. the wetlands within Stages I and II of Kakadu National Park).

The company must ensure that operations at Ranger mine do not result in:

- Damage to attributes for which the Kakadu National Park was inscribed on the World Heritage List.
- Damage to ecosystem health of the wetlands listed under the Ramsar Convention.
- Change to biodiversity, or impairment of ecosystem health, outside of the RPA.

ERA's management and monitoring programs are consistent with these objectives and will be extended, where required, to manage the Project.

Although there are no inherent or residual Class III or IV risks relating to flora and fauna (including threatened species) within the Project area, additional mitigation measures have been identified to further reduce risks to flora and fauna, and hence threatened species. These include (refer **Section 9.7**):

- Locating new infrastructure within the existing operational area, where possible.
- Dust deposition monitoring at sensitive receptors.
- Preventing access to boreholes and incorporating engineering controls to minimise fauna interacting with ventilation stacks.
- Rehabilitating cleared areas around new Project infrastructure to minimise sources of airborne dust on sediment runoff.
- Adopting noise control technology on equipment to meet noise criteria at sensitive receptors.
- Installing directional lighting to minimise disturbance to native fauna populations.

A fundamental aspect of current transport logistics for the Ranger mine is a range of pre-existing management practices and mitigation measures. These include:

- The contractor management system.
- Compliance with codes and regulations for the transport of dangerous goods.
- Conforming with the national heavy vehicle accreditation scheme.

- Hazard identification and risk management that requires transport providers to demonstrate they have a risk management system in place.
- Implementing the emergency response plan (if required).

These same controls will be utilised for the Project.

14.5.4 Likelihood of Significant Impacts to Threatened Species

The likelihood of significant impacts occurring to threatened species (whether critically endangered, endangered or vulnerable) was assessed in **Chapter 9** using the criteria in **Table 14-4**.

Table 14-4: Assessment of significant impacts to threatened species

Significant impact criterion ¹	Assessment of impact associated with the Project
Lead to a long-term decrease in the size of a population/important population ²	<p>It is unlikely³ that vegetation clearing will impact on local species' populations that are known to occur, i.e. the eastern partridge pigeon, as the species remains common in the undisturbed parts of the RPA or neighbouring Kakadu National Park.</p> <p>New surface disturbance will be limited to a small (<1 ha) highly disturbed area and is unlikely to lead to long-term impacts on the populations of threatened species (that are possible or likely to occur), or further population declines in species that have been in decline across the NT, e.g. northern quoll.</p> <p>Results of the ERICA assessment of radiological risk to terrestrial fauna (Section 9.3) show that the risk from estimated dose rates from the Project is insignificant, with all organisms having dose rates below the risk quotients.</p>
Reduce the area of occupancy of the species of a population/important population	<p>The removal of <1 ha of disturbed habitat is unlikely to reduce the area of habitat used by species as either:</p> <ul style="list-style-type: none"> • Species have not been recorded near the Project so the area is unlikely to support a population. • Species remain common in the undisturbed parts of the RPA. • Significant populations occur in the neighbouring Kakadu National Park.
Fragment an existing population/important population into two or more populations	<p>The proposed surface infrastructure will be within or adjacent to the existing mine disturbance footprint and therefore will not fragment any fauna populations or habitat.</p>
Adversely affect habitat critical to the survival of a species	<p>There is no critical habitat for species within or adjacent to the areas of surface disturbance.</p>
Disrupt the breeding cycle of a	<p>The Project is unlikely to disrupt breeding cycles as either:</p>

Significant impact criterion ¹	Assessment of impact associated with the Project
population/important population	<ul style="list-style-type: none"> • The area to be cleared does not include suitable breeding or feeding habitat for species. • The scale of clearance is unlikely to have any impact on the breeding cycles of the adjacent populations. • Vegetation clearing is unlikely to reduce prey abundance for the Northern masked owl, Red goshawk, Yellow chat or Bare-rumped sheath-tailed bat that would impact breeding. • Vegetation clearing is unlikely to impact food availability for the Brush-tailed rabbit-rat during their breeding season.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Clearance of <1 ha within the substantially disturbed Magela LAA will not reduce the availability or quality of habitat within the region.
Result in invasive species that are harmful to a critically engendered or endangered species becoming established in the endangered or critically endangered species habitat	Current operational pest management systems and procedures will apply to the Project. It is unlikely that any pest that could impact species' habitats will be introduced.
Introduce disease that may cause the species to decline	Current operational pest management systems and procedures will apply to the Project. The proposed action is unlikely to introduce a disease that would impact threatened species.
Interfere with the recovery of a species	<p>Current operational pest management systems and procedures will apply to the Project. The proposed action is therefore unlikely to:</p> <ul style="list-style-type: none"> • Introduce a disease that would impact threatened species. • Impact the spread or density of cane toads already present in the RPA (the recovery plan for the northern quoll focuses on mitigating the threat posed by cane toads). <p>The recovery plan for the bare-rumped sheath-tailed bat focuses on gathering information on the species and protecting roosting habitat. These goals will not be affected by the proposed Project.</p>

1. Criterion sourced from DEWHA (2013).

2. Where population relates to critically endangered and endangered threatened species and important population relates to vulnerable threatened species.

3. Refer **Section 9.5** for definition of unlikely.

Overall, the clearing of native vegetation associated with the Project is unlikely to have a significant impact on any threatened species at a regional or national scale. The Project involves clearing a small area of vegetation (<1 ha) within a substantially disturbed area that was previously used for land application disposal of excess water, and was also the subject of exploration clearing and drilling. Vegetation clearing will not cause fragmentation of existing habitat or fauna populations as the areas to be disturbed are located next to the

existing mine disturbance footprint. Although it is possible that some threatened species occur from time to time in the Magela LAA immediately east of the mine access road, the habitat is considered poor to good and substantial areas of high quality (excellent) habitat are available closer to Magela Creek.

Taking into account the air (including dust) and noise emissions, the likelihood of significant impacts occurring to threatened species remains unlikely, as low concentrations of air emissions are predicted (**Chapter 6**). While noise generated by the Project may cause occasional disturbance to fauna, the impact on habitat use will be minor (**Section 9.5.1**), and noise sensitive threatened species are likely to move to lower noise areas.

Chapter 8 describes how the Project is unlikely to have adverse incremental impacts on water quality in Magela Creek at MG009 (and further downstream) relative to those that are (and will be) associated with the existing Ranger mine. Therefore, impacts to listed threatened species from water pathways are likely to be negligible.

Sensitive ecological locations were identified along the road network and included rivers and associated wetlands and floodplains that provide habitat for large numbers of threatened and migratory species. A vehicle incident involving loss of containment (specifically, diesel (36 kL) and ammonia (23 t) has been identified as the highest ranked transport risk that could impact listed threatened species. This is a risk of major consequence⁴ for potential impacts to threatened species at all identified ecologically sensitive locations along the route; however, the likelihood of occurrence was assessed as rare (less than 0.1%)⁵ (**Appendix 8**).

14.6 ASSESSMENT OF IMPACTS TO MIGRATORY SPECIES

Information in **Section 14.6** is drawn from **Appendix 12** unless stated otherwise.

14.6.1 Studies and Surveys

A description of the studies and surveys that have been undertaken in the RPA are described in **Section 14.5.1**.

The assessment of listed migratory species along the transportation routes is described in **Section 12.2.1** and **Appendix 16** and involved a combination of desktop assessment (including a protected matters search) and site inspections. Listed migratory species within 5 km on each side of the transportation routes has been identified in **Appendix 16**.

14.6.2 Potential Impact Associated with the Project

The likely impact associated with the construction and operations of the Project is described in **Section 14.5.2**, for listed threatened species, and also applies to migratory species.

⁴ This is defined as moderate regional habitat modification, and/or lifecycle disruption and/or substantial decrease in the population size for a listed species (**Appendix 16**).

⁵ Rare is also defined as 'practically impossible' (refer **Appendix 16**).

14.6.3 Mitigation Measures

The mitigation measures described in **Section 14.5.3** also relate to the protection of migratory species.

14.6.4 Likelihood of Significant Impacts to Migratory Species

The likelihood of significant impacts occurring to migratory species was assessed in **Chapter 9** using the criteria in **Table 14-5**.

Table 14-5: Assessment of significant impacts to migratory species

Significant impact criterion ¹	Assessment of impact associated with the Project
Substantially modify, destroy or isolate an area of important habitat for migratory species	The removal of disturbed habitat directly adjacent to the existing mine disturbance is unlikely to negatively impact any habitat important for migratory species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for migratory species	Current operational pest management systems and procedures will apply to the Project. It is highly unlikely that any pest that could impact migratory species will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the populations of migratory species	The proposed area of disturbance has not been identified as a key habitat for migratory species as: <ul style="list-style-type: none"> Habitat for species is widespread in Australia and broadly distributed internationally. No breeding sites have been identified on the RPA or, in the case of the White-bellied sea eagle breeding site at Georgetown Billabong, the known breeding site will not be disturbed by the Project. Radiation dose rates to terrestrial organisms are insignificant (Section 9.3.4).

¹ Criterion sourced from DEWHA (2013).

Overall, the proposed Project is considered unlikely to have a significant impact on migratory species listed in **Table 14-3** at a regional or national scale. As noted in relation to threatened species, the Project involves clearing a small area within a substantially disturbed area. Although some migratory species are known to occur in the Magela LAA, the habitat values here are low, and the area beyond provides high quality habitat for a range of species.

The assessment of transport risks to listed threatened species described in **Section 14.5.4** also applies to migratory species. A vehicle incident involving loss of containment (diesel and ammonia) poses a risk of major consequence in terms of potential impacts to migratory species at all identified ecologically sensitive locations along the route; however, the likelihood of occurrence was assessed as rare (less than 0.1%) (**Appendix 16**).

14.7 WORLD HERITAGE PROPERTIES

14.7.1 Introduction

World heritage properties were identified as one of the controlling provisions for the Project (refer **Section 14.1.1**) and Kakadu National Park is the only world heritage property that was identified in the protected matters search (refer **Section 14.2**). The Project is located within the RPA, which is surrounded by, but separate from, the Park (refer **Figure 2-1**).

Kakadu National Park is one of only six Commonwealth national parks (Department of the Environment 2014b). The Park was declared under the *National Parks and Wildlife Conservation Act 1975* (NPWC Act) in three stages between 1979 and 1991, and was inscribed on the World Heritage List between 1981 and 1992 (Department of the Environment 2014b):

- Stage 1 (covering the leased land, and land required for the township of Jabiru and some adjoining areas) was declared on 5 April 1979 and inscribed in 1981.
- Stage 2 was declared on 28 February 1984 and inscribed in 1987.
- Stage 3 was declared progressively on 12 June 1987, 22 November 1989 and 24 June 1991, and inscribed in 1992.

Kakadu National Park was declared for the (DNP 2007):

- preservation of the area in its natural condition; and
- encouragement and regulation of the appropriate use, appreciation and enjoyment of the area by the public.

The *Kakadu National Park Management Plan 2007 – 2014* (DNP 2007) describes the national significance of the Park in terms of its biodiversity, natural and cultural heritage, and contribution to the Australian national conservation strategies. The board, Director and Park staff manage the Park in accordance with the EPBC Act, and all decision-making considers potential impacts to the Park's natural and cultural values (**Section 14.7.2**).

Kakadu National Park is one of the few sites listed under the World Heritage Convention for both cultural and natural values. A property included in the World Heritage List is a declared world heritage property under section 13(1) of the EPBC Act.

The EIS guidelines require the following to be addressed in relation to Kakadu National Park:

- A description of the world heritage values of the Kakadu National Park world heritage property (and this is addressed in **Section 14.7.2**).
- A description of the areas of the Kakadu National Park world heritage property that may be impacted by the Project (**Section 14.7.3**).
- Information on the proposed safeguards and mitigation measures (**Section 14.7.4**).
- A detailed assessment of potential impacts upon values of the Kakadu National Park world heritage property (**Section 14.7.5**).

14.7.2 Values

14.7.2.1 World Heritage List Selection Criteria

To be included on the World Heritage List, sites must be of outstanding universal value and meet at least one of the 10 selection criteria, as outlined in Operational Guidelines for the Implementation of the World Heritage Convention (World Heritage Centre 2013). Kakadu National Park is listed under the following criteria (UNESCO 2014):

Cultural criteria

- Criterion (i): Represent a masterpiece of human creative genius.
- Criterion (vi): Directly or tangibly associated with events or living traditions, with ideas, or beliefs, with artistic and literary works of outstanding universal significance.

Natural criteria

- Criterion (vii): Contain superlative natural phenomena or areas of exceptional natural beauty.
- Criterion (ix): Outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.
- Criterion (x): Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science and conservation.

14.7.2.2 Kakadu National Park Values

The Commonwealth Department of the Environment provides an assessment of Kakadu National Park's values against the World Heritage List selection criteria (Department of the Environment 2014c). Additional detail on these values is provided in **Table 14-6 (Section 14.7.5)**.

World heritage criterion (i) – masterpiece of the creative genius

Kakadu National Park is important to Aboriginal people, recognised as a unique archaeological and ethnological reserve that has been inhabited continuously for more than 40,000 years. The rock art sites in the Park represent an artistic achievement, spanning a continuum of tens of thousands of years to the present, and continuing to maintain an important function in the cultural and social aspects of contemporary indigenous communities.

World heritage criterion (vi) – directly associated with events or living traditions

Kakadu National Park is recognised for its association with events, ideas and beliefs of outstanding universal significance.

World heritage criterion (vii) – contains superlative natural phenomena

Kakadu National Park is recognised for having features of exceptional natural beauty and aesthetic importance and contains 'superlative' natural phenomena.

World heritage criterion (ix) – outstanding examples of ongoing evolution

Kakadu National Park is considered an outstanding example of the significant ongoing geological processes associated with the effects of sea-level change in the region, biological evolution and people's interaction with the natural environment.

World heritage criterion (x) – important habitats for conservation of biological diversity

The significant size (approximately 1,981,400 ha) and diversity of Kakadu National Park provides habitat for populations of rare or endangered flora and fauna species. The Park contains more than 77 species of mammals, 271 species of birds (more than a quarter of all Australian bird species), 132 species of reptiles, 27 species of frogs, 246 species of tidal and freshwater fish and over 10,000 species of insects (Department of the Environment 2014b; DNP 2007). The stone country, which forms much of the catchment of the South Alligator River and incorporates the sandstone escarpment of the Arnhem Land Plateau, contains over 30 species that are rare or endemic.

14.7.3 Project-related Activities in Kakadu National Park

The existing Ranger mine is located on the RPA. ERA manages Ranger mine under Commonwealth and Northern Territory regulations and conditions to minimise impacts and mitigate the potential for additional risks to the surrounding environment beyond the RPA, e.g. Kakadu National Park. The Project will develop an underground resource but will be fully contained on the RPA and all surface infrastructure, and associated land disturbance, will be located within the existing mine footprint or Magela LAA. **Chapters 6, 7, 8 and 9** have demonstrated that adverse impacts from Project air, noise and water emissions and discharges, and vibration, are unlikely beyond the RPA.

Approximately 50% of ERA's transport routes are located outside Kakadu National Park. While transportation activities will be very similar to current operations, the Project will require the transport of:

- Equipment for the construction of the ventilation shafts (and associated refrigeration), paste fill plant and additional power requirements.
- The underground mining fleet, e.g. boom development jumbo, underground haul trucks, load-haul-dump trucks, and shotcrete equipment.
- Construction consumables, e.g. concrete, transformers, electricity cabling.

- Operations consumables, e.g. diesel, sulfuric acid, lime, and cement and binding agent for paste fill.

Transportation activities associated with the Project may impact upon Kakadu National Park through an unplanned incident (refer **Chapter 12**).

14.7.4 Mitigation Measures

As described in **Section 14.5.3**, ERA is required to comply with the Ranger Environmental Requirements and maintain the attributes of Kakadu National Park. ERA implements a range of measures that mitigate emissions from the current operations at Ranger mine. These measures will continue to be implemented, where required, for the Project and will be supplemented with additional measures (as described in **Chapters 6, 7, 8, 9 and 10**) to:

- Suppress dust generated underground or surface haul routes and reduce dust from cleared areas.
- Reduce emissions from power generation and increase plume dispersion of air emissions.
- Ensure radiation dose to workers is below statutory limits and as low as reasonably achievable.
- Attenuate noise generated by equipment.
- Minimise risks to groundwater by using low permeability, cemented paste as mine backfill.
- Enhance the underground mine water management system, and maintain the existing site water management system.

Modelling predicts that Project emissions will be below criteria levels beyond the RPA, therefore the values of Kakadu National Park will continue to be protected.

ERA has developed a strong partnership with accredited transport companies to foster leading practice in the delivery of consumables/materials to and from the Ranger mine. Key transport safety elements include: specially engineered truck and trailer configurations, and braking systems; route evaluations; continuous driver training and assessment; global positioning satellite tracking of truck location and speed; satellite telephones for emergency contact; and emergency response facilities. The risk assessment undertaken as part of the transportation impact assessment did not identify additional or alternate controls that would materially reduce the likelihood or consequence of transport risks associated with the Project (refer **Section 12.8**).

The Ranger Environmental Requirements also require ERA to rehabilitate the Ranger Project Area such that it could be incorporated into Kakadu National Park (**Section 13.2**) and ensure that the surrounding environment of Kakadu National Park is not detrimentally impacted as a result of the mine closure.

ERA is currently in the process of developing closure criteria as benchmarks to measure these objectives. This also includes the development of a closure monitoring and reporting

program and mitigation measures should this monitoring demonstrate that closure is not progressing according to predicted trajectories.

This closure monitoring program will also apply to closure of the Project and will ensure that any detrimental impacts to Kakadu National Park are detected and reported.

14.7.5 Likelihood of Significant Impacts to World Heritage Properties

An action is considered likely to have a significant impact on world heritage values of a declared world heritage property, i.e. Kakadu National Park, if one or more world heritage values are (DEWHA 2013):

- lost;
- degraded or damaged; or
- notably altered, modified, obscured or diminished.

The likelihood of significant impacts occurring to the Kakadu National Park world heritage property was assessed against the values in **Table 14-6**. These values are specific to Kakadu National Park and address the world heritage values listed in DEWHA (2013) in greater detail.

Table 14-6: Assessment of significant impacts to Kakadu National Park's world heritage values

World heritage value ¹	Assessment of potential Project impacts to the value
World heritage criterion (i) – masterpiece of the creative genius	
Represent a unique artistic achievement and which comprise one of the greatest concentrations of rock art in the world.	Air quality modelling indicates that annual sulfur dioxide concentrations at Mt Brockman (the closest rock art site to the Project) will be significantly less than the criteria adopted for the Project (Section 6.3.1.2), and that Project air emissions will not result in rock art surface colour change. This finding can be extended to rock art more distant to the Project within Kakadu National Park. Similarly, vibration monitoring at Mt Brockman indicates that vibration associated with the Ranger 3 Deeps exploration decline is undetectable above background levels. Vibration associated with the Project is expected to be less, as blasting will occur at greater depths.
Are of great antiquity and which represent a continuous temporal span from the Pleistocene Epoch to the present.	
Exhibit great diversity, both in space and through time, yet embody a continuous cultural development.	
Demonstrate in the record of the art sites a living cultural tradition which continues today.	
World heritage criterion (vi) – directly associated with events or living traditions	
Form a rich collection of places imbued with strong spiritual associations relating to creator beings and are connected to the continuing practice of traditional beliefs and practices.	The closest cultural site to the Project is R34, which is located within the RPA and approximately 100 m north and east of ventilation exhaust 3b and ventilation intake 2, respectively. The site is located within a fenced exclusion zone and will not be disturbed by land clearing associated with the Project.
Demonstrate in the art and the archaeological record a	

World heritage value¹	Assessment of potential Project impacts to the value
living cultural tradition that continues today.	<p>Air quality modelling indicates that dust levels for the life of the Project will remain below the criteria for sensitive cultural receptors. Similarly, gas emissions associated with ventilation exhaust are not expected to affect R34 (refer Sections 6.4.3.1 and 10.4.1.3).</p> <p>Vibration monitoring at R34 indicates that vibration associated with construction of the Ranger 3 Deeps exploration decline is less than that associated with blasting in Pit 3, and that as the decline has progressed deeper, vibration has not been detectable above background levels. Vibration associated with underground mining is expected to be less again and well below Project criteria (refer Section 6.7.5). Vibration resulting from the construction of the ventilation shafts is not expected to be detectable at this site (refer Sections 6.11.1.1 and 10.4.1.3).</p> <p>It is expected that these findings are equally applicable, if not more so, to more distant cultural sites (that also represent spiritual values) located within the RPA and the Park.</p>
Are of great antiquity and represent a continuous temporal span from the Pleistocene Epoch to the present.	
Include archaeological sites which are currently some of the oldest dated within Australia.	
Exhibit great diversity, both in space and through time, yet embody a continuous cultural development.	
Preserve a record, not only in the form of archaeological sites but also through rock art, of human responses and adaptation to major environmental change including rising sea levels.	
Preserve fragile items of material culture not commonly found within other archaeological sites.	
World heritage criterion (vii) – contains superlative natural phenomena	
Expansive and varied natural landscapes that include coastal areas, lowlands, wetlands, floodplains, plateau complexes, escarpments and outliers.	The landscape within Kakadu National Park will not be impacted. The area to be cleared for the Project is within an existing disturbed area and insignificant (<1 ha) relative to the area of Kakadu National Park (approximately 1,981,400 ha).
Exceptional natural beauty of viewfields.	<p>Surface infrastructure for the Project will be constructed within an existing mine facility which includes stockpiles up to 80 m high, the 40 m high crusher, the brine concentrator at 25 m, and the heavy vehicle maintenance workshop (16 m). The tallest components of the surface infrastructure for the Project will be the ventilation stacks at 12 m. Vegetation surrounding the mine site varies in height, with the tallest vegetation (> 10 m) found along the creek lines.</p> <p>Views to the mine site are predominantly restricted to the RPA and Mt Brockman. Ranger mine is also visible from planes flying over the mine site from Jabiru Airport. However, it will be difficult to distinguish the surface infrastructure for the Project from the existing surface infrastructure.</p> <p>Views to the mine site will be obstructed from most observation locations by natural screening vegetation, especially along Magela Creek. The exception to this is various locations along the mine access road.</p> <p>The viewshed of the ventilation stacks is mainly limited to the existing mine footprint, particularly areas of high elevation such as stockpiles. Based on the viewshed analysis, the maximum estimated distance that an observer will see the ventilation</p>

World heritage value ¹	Assessment of potential Project impacts to the value
	<p>stacks (outside of the mill and plant areas) is approximately 800 m for Exhaust 1, and 400 m for Exhaust 4a. The ventilation stacks will not be visible from areas north of Magela Creek.</p> <p>Viewfields within Kakadu National Park will not be impacted by the Project.</p>
Relatively undisturbed nature of the landscape.	The landscape within Kakadu National Park will not be impacted. The area to be cleared for the Project is within an existing disturbed area and insignificant (<1 ha) relative to the RPA (7,867 ha) and area of Kakadu National Park (approximately 1,981,400 ha).
Unusual mix and diversity of habitats found in close proximity.	ERA has a 30 year history of protection of the surrounding environment. The Australian Government's Supervising Scientist Division 2012 – 2013 annual report states "The extensive monitoring and research programs of the Supervising Scientist Division (Supervising Scientist 2013) confirm that the environment has remained protected through the period." (Supervising Scientist 2013). The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the mix and diversity of habitats found within the Park (refer Section 14.5).
Large scale of undisturbed landscape.	The landscape within Kakadu National Park will not be impacted. The area to be cleared for the Project is within an existing disturbed area and insignificant (<1 ha) relative to the RPA (7,867 ha) and area of Kakadu National Park (approximately 1,981,400 ha).
World heritage criterion (ix) – outstanding examples of ongoing evolution	
Coastal riverine and estuarine flood plains of the South Alligator, West Alligator, East Alligator, and Wildman rivers, which include freshwater flood plains with tidal river channels.	<p>Releases of water to the Magela Creek (which eventually becomes a tidal channel and joins the East Alligator River) are controlled and managed based on flow and monitoring of water quality against objectives. Objectives have been established to ensure that mine-derived constituents do not impact on the receiving environments (refer Section 8.2).</p> <p>A comprehensive landscape ecological risk assessment of the Magela Creek floodplain in the Park was reported in Bayliss, <i>et al.</i> (2012). The assessment concluded that risks from mine water contaminants are an order of magnitude lower than non-mining landscape risks, e.g. weeds and feral animals. The authors also concluded: "...that if the world heritage values of the Magela Creek floodplain are to be maintained, then non-mining landscape-scale risks need to receive a similar level of close scrutiny as applied to uranium mining risks, with concomitant levels of investment needed to manage these risks."</p>

World heritage value ¹	Assessment of potential Project impacts to the value
	<p>The Project will contribute to the volume of water that will be released to Magela Creek, but ERA will continue to manage this water in accordance with their water management objectives to minimise risks to the environment beyond the RPA. The Project will not affect the water quality in discharges from Ranger mine to Magela Creek, or the hydrology of Magela Creek.</p>
<p>Relatively undisturbed nature of the river systems and their associated catchments.</p>	<p>The entire RPA falls within the Magela Creek catchment, which covers an area of approximately 160,000 ha.</p> <p>The area to be disturbed by the Project comprises <1 ha (which is approximately 0.001% of the catchment). The Magela Creek discharges to the Magela Creek floodplain and, ultimately, into the Van Diemen Gulf via the East Alligator River. There will be no Project-derived adverse impacts to downstream water quality as determined by compliance with current water quality objectives at MG009 (refer Section 8.5). Therefore, impacts to the river systems from the Project are expected to be insignificant.</p>
<p>Mangrove swamps, including remnants of more extensive swamps which formed between 6,500 and 7,000 years ago on the coastal fringe and plains.</p>	<p>The main threats to the existing mangrove communities are driven by climate change effects. It is not the rise in sea level that is important but the rate of rise (Bayliss, <i>et al.</i> 1997). Mangroves are likely to opportunistically colonise areas such as the South Alligator River floodplain (which would expand their current distribution) if they were inundated with seawater (Bayliss, <i>et al.</i> 1997).</p> <p>Mangrove swamps will not be impacted as a consequence of the Project due to its distance from the tidal wetlands of the Park and the water quality objectives that define the manner in which water is managed on, and released from, site.</p>
<p>Spatial zonation of the coastal and floodplain vegetation which exemplifies a vegetation succession linked to processes of sea level change and sedimentation and extends from lower intertidal mangroves to estuarine mangroves to floodplain vegetation.</p>	<p>Mangroves will not be impacted as a consequence of the Project due to its distance from the tidal wetlands of the Park and the water quality objectives that define the manner in which water is managed on, and released from, site.</p> <p>The Project will not promote sea level change that could consequently produce changes to coastal and floodplain vegetation.</p> <p>Additional volumes of release water associated with the Project will not cause material change to Magela Creek hydrology and floodplain vegetation (refer Section 8.5).</p>
<p>Range of the environmental gradients and contiguous, diverse landscapes, extending from the sandstone plateaus and escarpments through lowland areas and wetlands to the coast, which have contributed to the evolution of high levels of endemism and species</p>	<p>The landscape within Kakadu National Park will not be impacted. The area to be cleared for the Project is within an existing disturbed area and insignificant (<1 ha) relative to the area of Kakadu National Park (approximately 1,981,400 ha).</p>

World heritage value ¹	Assessment of potential Project impacts to the value
<p>diversity.</p> <p>The scale and integrity of the landscapes and environments with extensive and relatively unmodified vegetation cover and largely intact faunal composition which are important in relation to ongoing evolutionary processes in an intact landscape.</p>	<p>ERA has a 30 year history of protection of the surrounding environment. The Australian Government's Supervising Scientist Division 2012 – 2013 annual report states "The extensive monitoring and research programs of the SSD confirm that the environment has remained protected through the period." (Supervising Scientist 2013). The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p>
<p>High spatial heterogeneity of habitats.</p> <p>High diversity and abundance of plant and animal species, many of which are adapted to low-nutrient conditions (including more than 1,600 plant species, over one-quarter of Australia's known terrestrial mammal and about one-third of the total bird fauna and freshwater fish species, about 15% of Australia's reptile and amphibian species, and a high diversity of insect species).</p>	<p>A small area of vegetation (<1 ha) will be cleared from within, and adjacent, to a highly disturbed area. The area east of the Project, and beyond within the RPA, provides high quality (excellent) fauna habitat values for a range of species including birds, mammals and reptiles.</p> <p>The Project is unlikely to impact on local species' populations or reduce the area of habitat used by species.</p>
<p>Aboriginal archaeological remains and rock art which represent an outstanding example of people's interaction with the natural environment and bear remarkable and valuable witness to past environments in northern Australia and to the interaction of people with these environments.</p>	<p>Air quality modelling indicates that annual sulfur dioxide concentrations at Mt Brockman (the closest rock art site to the Project) will be significantly less than the criteria adopted for the Project (Section 6.3.1.2), and that Project air emissions are not expected to result in rock art surface colour change. This finding can be extended to rock art more distant to the Project, within Kakadu National Park.</p> <p>Similarly, vibration monitoring at Mt Brockman indicates that vibration associated with the Ranger 3 Deeps exploration decline is undetectable above background levels. Vibration associated with the Project is expected to be less as blasting will occur at greater depths.</p>
<p>Ongoing, active management of the landscapes by Aboriginal people through the use of fire, including fire-assisted hunting and the creation of environmental mosaics which contribute to species diversity, provide an important example of people's interaction with the environment.</p>	<p>ERA conducted a traditional burning program in 2011 and 2012, allowing traditional owners to conduct active fire management on the ERA leases. This program has not been continued, but traditional owners will continue traditional burning practices on parts of the RPA north of Magela Creek. This practice will not be affected by the Project.</p>
<p>Diverse range of habitats and vegetation types including:</p> <ul style="list-style-type: none"> • Open forest and woodlands. • Lowland and sandstone (<i>Allosyncarpa ternata</i> closed forest) rainforests. • Shrubland and heath. • Wetland, riverine, and coastal environments. 	<p>The <1 ha of habitat to be cleared on the RPA is predominantly eucalypt woodland and shrubland, which is widespread across the Top End.</p> <p>No habitat within Kakadu National Park will be impacted.</p> <p>The Ranger mine Environmental Requirements require ERA to rehabilitate the Ranger mine to establish an environment similar to the adjacent Kakadu National Park.</p>

World heritage value ¹	Assessment of potential Project impacts to the value
<ul style="list-style-type: none"> Mangroves and floodplains. 	
World heritage criterion (x) – important habitats for conservation of biological diversity	
<p>A wide range of natural habitats:</p> <ul style="list-style-type: none"> Open forest and woodlands. Monsoon rainforest areas. Heaths and shrublands. Freshwater wetlands. Mangrove and estuarine areas. Foreshore and beach areas. 	<p>The <1 ha of habitat to be cleared on the RPA is predominantly eucalypt woodland and shrubland, which is widespread across the Top End.</p> <p>No habitat within Kakadu National Park will be impacted.</p> <p>The Ranger mine Environmental Requirements require ERA to rehabilitate the Ranger mine to establish an environment similar to the adjacent Kakadu National Park.</p>
<p>Significant plant associations, including those associated with <i>Eucalyptus koolpinensis</i>, the heath vegetation on the margins of the Marrawal Plateau, and woodland containing <i>Terminalia platyptera</i> on Snake Plains.</p>	<p>Flora and vegetation surveys for the Ranger mine, and more recently the Project, did not identify any vegetation communities of conservation significance within 4 km of the mine site (Appendix 12). The Project is unlikely to impact significant plant associations within the Park.</p>
<p>Plant species of conservation significance (including endemic species and relict species) such as <i>Arthrochilus byrnessii</i>, <i>Cycas conferta</i>, <i>Desmodium</i> sp. 2, <i>Eucalyptus koolpinensis</i>, <i>Hildegardia australiensis</i>, <i>Micraira</i> spp., <i>Neobyrnesia suberosa</i>, <i>Pityrodia</i> spp., <i>Plectrachne aristiglumis</i>, <i>Triodia radonensis</i>, <i>Typhonium russell-smithii</i>.</p>	<p>Flora and fauna surveys for the Ranger mine, and more recently the Project, did not identify any plant species of conservation significance within 9 km of the mine site (Appendix 12). The Project is unlikely to impact plant species of conservation significance within the Park.</p>
<p>Animal species of conservation significance, including:</p> <ul style="list-style-type: none"> Mammals (such as Calaby's mouse <i>Pseudomys calabyi</i>, Kakadu dunnart <i>Sminthopsis</i> sp. Nov., nabarlek <i>Petrogale concinna</i>, false water rat <i>Xeromys myoides</i>, golden backed tree rat <i>Mesembriomys macrurus</i>, and ghost bat <i>Macroderma gigas</i>). Reptiles (such as pig-nosed turtle <i>Carettochelys insculpta</i>, Pacific or olive ridley turtle <i>Lepidochelys olivacea</i>, green turtle <i>Chelonia mydas</i>, loggerhead turtle <i>Caretta caretta</i>, saltwater crocodile <i>Crocodylus porosus</i> and freshwater crocodile <i>C. johnstoni</i>). Birds (such as Gouldian finch <i>Erythrura gouldiae</i>, partridge pigeon <i>Geophaps smithii smithii</i>, hooded parrot <i>Psephotus dissimilis</i>, little tern <i>Sterna albifrons</i>, masked owl - northern subspecies <i>Tyto novaehollandiae kimberli</i> and red goshawk 	<p>The eastern partridge pigeon (<i>Geophaps smithii smithii</i>) is the only Commonwealth listed threatened species that was recorded during the flora and fauna surveys for the Project. However, it was not recorded within the footprint of the Project, but was found within the Magela LAA along the southern banks of Corridor Creek upstream of Georgetown Billabong.</p> <p>Listed migratory species recorded during the flora and fauna surveys for the Project, including the freshwater crocodile (<i>Crocodylus johnstoni</i>), were found within the Magela LAA (especially around the Georgetown Billabong), but not within the proposed Project's footprint.</p> <p>None of the other species listed in this criterion were identified during the flora and fauna surveys for the Ranger mine and Project.</p> <p>A comprehensive aquatic survey was undertaken in the 2009 within a 30 km radius of Ranger mine. No listed or endangered macroinvertebrate or fish species were recorded, and there were</p>

World heritage value ¹	Assessment of potential Project impacts to the value
<p><i>Erythrorichis radiatus</i>).</p> <ul style="list-style-type: none"> • Invertebrates (such as crustaceans of the plateau and escarpment streams, especially the families Amphispodidae, Atyidae and Palaemonidae). • Fish (such as two newly discovered taxa of goby, including the new genus <i>Cryptocentrus</i>, and a speartooth shark <i>Gyphis</i> sp). • Species which have experienced range reductions (such as the magpie goose <i>Anseranas semipalmata</i>, Gouldian finch <i>Erythrura gouldiae</i>, partridge pigeon <i>Petrophassa smithii</i>, pale field rat <i>Rattus tunneyi</i> and Leichhardt's grasshopper <i>Petasida ephippigera</i>). • Endemic species and relict species (including ghost bat <i>Macroderma gigas</i>, orange horseshoe bat <i>Rhinonictis aurantius</i>, saltwater crocodile <i>C. porosus</i>, freshwater crocodile <i>C. johnstoni</i>, and pignosed turtle <i>Carettochelys insculpta</i>). 	<p>no species considered rare or restricted in distribution (refer Section 2.5.5).</p> <p>The assessment of radiation doses to aquatic and terrestrial organisms concluded that estimated dose rates will not pose a risk to aquatic (in Magela Creek downstream of Ranger mine) or terrestrial organisms (Section 9.3.4).</p> <p>The assessment of Project-related impacts on species of conservation significance is provided in Chapter 9 and Section 14.5. The Project is unlikely to impact fauna species of conservation significance within Kakadu National Park.</p>

¹ Values described in Department of the Environment (2014b).

In addition to MNES (prescribed actions) that may require assessment, the EPBC Act also outlines "special rules for some Commonwealth reserves", e.g. Chapter 5, Part 15, Division 4(G)(387)(2)(b) of the act does not prevent the transport of mine-related materials in the Kakadu National Park along routes (including air routes) prescribed by the act's regulations. The loss of containment or uncontrolled release of dangerous goods during transport to or from site (along the Arnhem and Kakadu highways), although unlikely, is recognised as a business critical risk and is managed accordingly. **Chapter 12** has described the lack of material change to the transport risk profile as a result of the Project. **Section 14.5.4** identified that a vehicle incident involving loss of containment (specifically, diesel and ammonia) has been identified as the highest ranked transport risk that could impact listed threatened species. Similarly, diesel and ammonia were assessed as posing a risk of major consequence⁶ in terms of impacts to environmental values, i.e. world heritage values, at all identified ecologically sensitive locations along the route; however, this represents an unplanned event, the likelihood of which was assessed as rare (less than 0.1%) (**Appendix 16**).

Where possible, the assessments presented in **Table 14-6**, and above, quantify and describe the geographic extent and duration of impacts associated with the Project. The assessments also describe how it is expected that the world heritage values of Kakadu National Park will be maintained during planned activities associated with Project construction, operations and closure. Therefore, it is expected that the Project will not have a significant impact on Kakadu National Park's world heritage values.

⁶ Defined as widespread and long-term impact, long periods of recovery (**Appendix 16**).

14.8 NATIONAL HERITAGE PLACES

In 1997, the Council of Australian Governments decided that heritage listing and protection should be the responsibility of the government best placed to deliver agreed outcomes, and that the Commonwealth's involvement in environmental matters would focus on matters of national environmental significance, including world heritage properties and places of national significance, with each state, territory and local government having a similar responsibility for its own heritage.

This led to the creation of two new heritage lists under the EPBC Act in 2003:

- National Heritage List, which includes and protects places of outstanding heritage value to the nation.
- Commonwealth Heritage List, which includes and protects heritage places owned or controlled by the Commonwealth.

Australia's national heritage comprises exceptional natural and cultural places that contribute to Australia's national identity and encompasses those places that reveal the richness of Australia's diverse natural heritage. The National Heritage List is a list of natural, historic and indigenous places that are of outstanding heritage significance to Australia.

On 15 May 2007, the Minister for the Environment and Water Resources determined that Kakadu National Park met eight national heritage criteria in accordance with sub item 1A(3) of Schedule 3 of the *Environment and Heritage Legislation Amendment Act (No.1) 2003* (DEWR 2007) (**Table 14-7**), where if a place has a world heritage value, it is understood to meet a national heritage criterion. Kakadu National Park, therefore, was one of 15 world heritage places included in the National Heritage List under the EPBC Act on 21 May 2007.

Table 14-7: Kakadu National Park national heritage values and criteria

National heritage values ¹	Criteria
<ul style="list-style-type: none"> • Events, processes • Rarity • Research • Principal characteristics of a class of places • Aesthetic characteristics • Creative or technical achievement • Social value • Indigenous tradition 	<p>This place is taken to meet this national heritage criterion in accordance with sub-item 1A(3) of Schedule 3 of the <i>Environment and Heritage Legislation Amendment Act (No.1) 2003</i>, as the World Heritage Committee has determined that this place meets the relevant World Heritage criteria:</p> <ul style="list-style-type: none"> • Events, processes: (vi), (ix) and (x). • Rarity: (x). • Research: (ix) and (x). • Principal characteristics of a class of places: (ix). • Aesthetic characteristics: (vii). • Creative or technical achievement: (i). • Social value: (vi). • Indigenous tradition: (vi).

¹ Criterion sourced from AHC (2009).

Of the 15 NT places listed in the Commonwealth Heritage List, the Mount Bunday military training area (near Humpty Doo) is the closest to the Ranger mine, but is still 135 km distant. The training area is used by the Department of Defence (Department of Defence 2013) and has a high diversity of significant fauna habitats (Department of the Environment 2014d).

The national heritage values and criteria are analogous to the world heritage values for Kakadu National Park. These values, and Project-related mitigation measures and assessment of the potential impacts upon these values, are described in **Sections 14.7.2, 14.7.4 and 14.7.5**, respectively.

An action is considered likely to have a significant impact on national heritage values of a national heritage place, i.e. Kakadu National Park, if one or more national heritage values are:

- lost;
- degraded or damaged; or
- notably altered, modified, obscured or diminished.

The assessment in **Section 14.7.5** explains how it is expected that Kakadu National Park's world heritage values will be maintained during planned activities associated with the Project. This infers that Kakadu National Park's national heritage values will also be maintained. Therefore, the Project is not likely to have a significant impact on a national heritage place.

14.9 WETLANDS OF INTERNATIONAL IMPORTANCE

14.9.1 Introduction

The Convention on Wetlands of International Importance was agreed in 1971 in the Iranian town of Ramsar. Since then, the convention has been known as the Ramsar Convention. The Ramsar Convention encourages the designation of sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity, where wetlands can be natural or manmade habitats. Once designated, wetlands are added to the Ramsar List of Wetlands of International Importance and become known as Ramsar sites that require a management framework aimed at conserving the wetland and protecting its ecological character (Department of the Environment 2014e).

Australia was one of the first countries to sign the Ramsar Convention. The Kakadu National Park Ramsar site was historically two separate sites, which reflected the staged declaration of the Park (BMT WBM 2010):

- Kakadu National Park Stage 1 was listed as a Ramsar site in 1980 and expanded in 1995 to include the wetland components in Kakadu National Park Stage 3.
- Kakadu National Park Stage 2 was listed as a Ramsar site in 1989.

In April 2010, the two Kakadu National Park Ramsar sites were merged to form a single Ramsar site and extended to include the remaining areas of Kakadu National Park Stage 3. This merger and expansion resulted in the Ramsar site boundary being the same as the national park boundary.

Ramsar site nomination criteria have changed since the site was first nominated. BMT WBM (2010) and BMT WBM (2011) provide an assessment of the Kakadu National Park Ramsar site against the previous and current criteria. The Kakadu National Park Ramsar site meets all nine of the current criteria (**Table 14-8**).

Table 14-8: Ramsar site criteria

Criterion ¹	Kakadu National Park Ramsar site ²
1. A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	The wetland types occurring within Kakadu National Park are representative of types found in the bioregion and are in natural or near-natural condition. In particular, the floodplains are outstanding examples of their types in the Timor Sea Drainage Division of the monsoon tropics. Field Island is also particularly notable as it represents a remarkably high level of habitat diversity within a relatively small area.
2. A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities.	Kakadu National Park supports numerous nationally threatened wetland-dependent fauna species, notably the yellow chat, pig-nosed turtle, spear-tooth shark, northern river shark and flatback turtle.
3. A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Kakadu National Park has a rich biological diversity representative of the region ³ : <ul style="list-style-type: none"> • 59 fish species are known, including 8 with narrowly restricted ranges and 4 that are regionally endemic. • 61 mammal species, including 4 that are wetland-dependent. • 105 reptile species, including 20 that are wetland-dependent. • 26 frog species. • 267 bird species, including 91 waterbirds and 28 migratory species. • 1,600 plant species of which 4 are regionally endemic wetland-dependent flora species.
4. A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.	Kakadu National Park provides breeding habitat for significant waterbird aggregations. Significant breeding groups of magpie geese occur throughout the floodplains of the site. South and East Alligator rivers support multi-species colonies of birds exceeding 13,000 and 11,500, respectively. The permanent wetlands within the site (particularly billabongs) provide a dry season refuge for a variety of species including waterbirds, reptiles such as crocodiles and freshwater turtle, and freshwater fish. The site also provides feeding, roosting and refuge habitat for shorebirds, waterbirds and terrestrial vertebrate fauna species.
5. A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.	The total waterbird population for the Alligator Rivers Region during the late dry season is likely to be in excess of 2.5 million birds.

Criterion ¹	Kakadu National Park Ramsar site ²
6. A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Eight waterbird species have been recorded within Kakadu National Park in numbers that exceed 1% of the estimated population size: magpie goose, wandering whistling-duck, plumed whistling-duck, Radjah shelduck, Pacific black duck, grey teal duck, brolga and black-necked stork. Five migratory shorebirds have been recorded within Kakadu National Park in numbers that exceed 1% of the estimated population size in East Asia: marsh sandpiper, little curlew, common sandpiper, Australian pratinole and sharp-tailed sandpiper.
7. A wetland should be considered internationally important if it supports significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and therefore contributes to global biodiversity.	Fifty-nine freshwater fish species have been recorded in Kakadu National Park. This represents approximately 20% of the total number of fish species found in Australian freshwaters (302 species) and is the highest species richness (60%) of any catchment in the Timor Sea Drainage Division (approximately 100 species).
8. A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	Kakadu National Park provides important habitats, feeding areas, dispersal and migratory pathways, and spawning sites for numerous fish species of direct and indirect fisheries' significance. These fish have important fisheries resource values both within and external to the Ramsar site.
9. A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.	Kakadu National Park supports more than 1% of the population of the following species: northern river shark, speartooth shark, pig-nosed turtle and saltwater crocodile.

¹ Criterion sourced from BMT WBM (2011).

² Source: BMT WBM (2011) and Department of the Environment (2014f)

³ Species diversity numbers reflect source reports; therefore, there is some variation in numbers throughout the EIS.

14.9.2 Ecological Character

The Kakadu National Park Ramsar site is a series of wetlands comprising two large river catchments, the East and South Alligator rivers, as well as seasonal creeks and the lower reaches of the East Alligator River. It also includes the Magela Creek floodplain, the lower South Alligator floodplain, and nearly the entire West Alligator River and Wildman River systems (Department of the Environment 2014f).

The ecological character description of the Ramsar site recognises that the site has the following qualities (BMT WBM 2010):

- representative wetland habitats at a bioregional level;⁷
- support for vulnerable wetland species' populations;
- a centre of endemism and high biodiversity, including diversity of habitats;
- support for key life-cycle functions such as waterbird breeding and refugia;

⁷ Since the EIS Guidelines were released the Outstanding Universal Values provided on the UNESCO website for Kakadu National Park have become the formal statement for the property and can be viewed at: <http://whc.unesco.org/en/list/147>.

- support for substantial populations of waterbirds and fish diversity, nursery and spawning habitats; and
- support of at least 1% of the national population of several non-avian wetland species.

Critical components and processes of the Ramsar site include:

- Key wetland habitats and populations of waterbirds, freshwater fish, aquatic invertebrates, turtle and crocodiles.
- Critical ecosystem processes that underpin the habitats of the site. These include hydrology, fire regimes and notable biological processes such as breeding of waterbirds and turtle nesting, with supporting processes including climate, tidal hydraulics, groundwater, water quality, geology and geomorphology.

These components and processes provide the basis for a broad range of ecosystem services/benefits, including threatened fauna, endemic species, fisheries resource values and contemporary living culture.

Threats that may affect future ecological character of the Ramsar site include:

- introduction and/or proliferation of exotic flora and fauna;
- climate change;
- tourism and recreational activities (including boating);
- mining activities;
- damage to archaeological resources and rock art; and
- living resource extraction.

Of these threats, future impacts from climate change in terms of increased saltwater intrusion and impacts from the continuing persistence and spread of cane toads are seen as the most likely and potentially severe (Bayliss, *et al.* 2012).

There are no Ramsar listed wetlands on the RPA.

14.9.3 Potential Impact Associated with the Project

As described in **Section 14.7.3**, the Project will develop an underground resource but will be fully contained on the RPA and all surface infrastructure, and associated land disturbance, will be located within the existing operational footprint or Magela LAA.

The underground mine will intercept groundwater that will be pumped to the surface (refer **Section 3.5.4** and **Section 3.7.2**). This water will mix with other surface waters on the site and be managed in accordance with the Ranger mine's water quality objectives and current water management strategy (refer **Chapter 8**). This will involve managed releases from Retention Pond 1 (RP1) and Corridor Creek during the wet season or irrigation via LAAs during the dry season. Water that is released to Magela Creek will ultimately report to

Kakadu National Park and the Ramsar wetlands system, although the volumes from the Project will be very small compared with the volume of water in the wetlands.

Post closure, solutes such as magnesium from underground backfill materials will travel very slowly via groundwater to Magela Creek, with a final destination being the same wetlands in Kakadu National Park. Solute transport has been modelled over a 10,000 year time period, and the results indicate that the amount of material derived from the Project and reporting to the creek over this period will be negligible compared with natural loads in the creek. This is discussed in detail in **Chapter 8** and **Chapter 13**.

14.9.4 Mitigation Measures

A primary environmental objective of the Ranger Environmental Requirements is that ERA maintains the ecosystem health of wetlands listed under the Ramsar Convention.

Surface water is currently managed by the existing water management system that operates in accordance with a set of operating rules that specify when water can be released from site. These releases only occur in accordance with specific water quality objectives. Surface water associated with the Project will be managed by the existing water management system that has sufficient capacity to handle the additional volume of water that will be generated by the Project (refer **Chapter 8**).

Other mitigation measures that will be implemented to manage surface and groundwater associated with the Project include:

- Installing secondary containment of pipes, quick connect nozzles and fast fill connections to contain hydrocarbon spills.
- Retaining a rock pillar between Pit 3 to Ranger 3 Deeps to eliminate seepage from the pit to underground workings.
- Establishing protocols for the placement of paste backfill regarding water management.
- Washing tailings prior to use in paste backfill to lower entrained solutes.
- Designing backfill paste to have low permeability, low moisture content and cement binding.
- Backfilling ventilation raises on closure to prevent solute transport pathways.

Monitoring and mitigation of any potential post closure impacts to the Ramsar wetlands will be the same as for current Ranger operations closure. This program is currently being developed concurrently with closure criteria (refer **Section 14.7.4**). In order to demonstrate that there is no detrimental environmental impact to Kakadu National Park (and the Ramsar wetland) from solutes generated from tailings the closure criteria working group, in consultation with ARRTC, have agreed to use the method "limits of acceptable change" to develop Ranger water and sediment closure criteria. This method was developed for assessing the change to the ecological character values of Ramsar Wetlands.

By incorporating this method into the monitoring and mitigation program any long term post closure impacts from the Project to the ecological character values of the Ramsar wetland will be detected and reported.

14.9.5 Likelihood of Significant Impacts on the Kakadu National Park Ramsar Wetland

The SSD has conducted extensive monitoring and research of water quality, benthic macroinvertebrate and fish communities in Magela and Gulungul creeks bounding the existing Ranger mine, as well as in creeks more distant from the RPA (Supervising Scientist 2013). Additional research has been carried out intermittently on mussels in downstream billabongs, as well as in control billabongs elsewhere in Kakadu National Park, from 1981 to the present. This research is undertaken to ensure that mussels are fit for human consumption and that mussel tissues and organs do not contain elevated levels of metals and/or radionuclides that could have been derived from uranium mining. Responses of in situ aquatic animals that are exposed to waters from the Ranger mine have also been regularly evaluated to check for toxicity. Based on this monitoring program, the SSD has concluded that (SSD 2013):

- The aquatic environment in Magela Creek has remained protected from mining activities.
- There is no evidence of mine-related effects upon snail egg production in Magela and Gulungul creeks over the wet season.
- There is no evidence of issues of potential concern with regards to bioaccumulation of radionuclides and metals in fish from Mudginberri Billabong.
- The concentrations of uranium in mussels from Mudginberri Billabong have been low and constant from 2000 – 2012, with no evidence of an increasing trend in concentration over time due to a mining influence.⁸
- The difference in radionuclide burdens in mussels in Mudginberri Billabong was due to natural catchment influences and differences in water chemistry, rather than mining-related inputs to Magela Creek.
- Radium-226 and polonium-210 activity concentrations in aged mussels from Mudginberri Billabong were similar to the average from previous collections; and
- Changes to water quality downstream of Ranger mine as a consequence of mining during the period 1994 to 2013 have not adversely affected macroinvertebrate communities nor affected fish communities in channel billabongs.

Evidence from Bayliss, *et al.* (2012) and Supervising Scientist (2013) indicates that risks from mine water contaminants are an order of magnitude lower than non-mining landscape risks (aquatic weeds, feral pigs, cane toads, unmanaged dry season fires, and saltwater intrusion), that existing Ranger operations have had no effect on aquatic ecosystems and Ramsar

⁸ The last sample was taken in October 2012.

wetlands and, in particular, the bioaccumulation of mine-derived contaminants in wetlands biota likely to be consumed by people from local and regional communities.

The Project is not expected to indirectly contribute to the non-mining landscape threats mentioned above:

- The pest management systems and procedures that ERA currently implements will apply to the Project to control invasive species (such as wetland weeds mimosa, para grass and salvinia, and feral pigs).
- ERA's fire management plans will minimise the risk of unmanaged dry season fires occurring outside the RPA.
- The Project will not exacerbate sea level change that would result in saltwater intrusion that could inundate vulnerable coastal freshwater wetlands.

The likelihood of significant impacts occurring to the Kakadu National Park Ramsar wetland due to the Project was assessed using the criteria in **Table 14-9**. The assessment demonstrates that significant impacts on a wetland of international importance are not expected.

Table 14-9: Assessment of significant impacts to wetlands of international importance

Significant impact criterion ¹	Assessment of Project impact
Areas of the wetland being destroyed or substantially modified	There are no sensitive environments (significant breeding sites, seasonal habitats or wetlands areas) of special significance including RAMSAR sites in the footprint of Ranger operations or in the RPA. The small clearance footprint (<1 ha) proposed for the Project is restricted to the RPA. In addition:
A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland	<ul style="list-style-type: none"> • Clearance of <1 ha of previously disturbed Eucalypt woodland on the RPA will not have downstream effects on the Kakadu National Park wetlands. No riparian habitat will be cleared as part of the Project.
The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	<ul style="list-style-type: none"> • Increased discharges to surface water, associated with the Project, will occur during the wet season when the Magela Creek system will be in flood, and in accordance with current operating rules. Using conservative estimates, these discharges will represent < 0.5% of total annual discharge in Magela Creek (at MG009) (refer Section 8.5), and will not result in a substantial and measurable change to the hydrological regime of the wetlands.
A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health	<ul style="list-style-type: none"> • Groundwater inputs from the underground mine after closure are orders of magnitude less and pose an even smaller risk to

Significant impact criterion ¹	Assessment of Project impact
<p>An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.</p>	<p>the hydrological regime of the wetlands.</p> <ul style="list-style-type: none"> • Groundwater modelling has shown that there will be no measureable impacts to groundwater levels at and near Magela Creek. A drawdown of 1 cm in the shallow groundwater system is predicted to extend no closer than 400 m from Magela Creek (refer Section 8.5). Therefore, drawdown associated with underground mining won't influence downstream wetlands. • There will be no change in the quality of surface water releases from the mine associated with the Project as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality of the wetland. • The amount of material that will be leached from backfill material placed in the underground mine on closure and subsequently report to Magela Creek via groundwater movement will be negligible over a 10,000 year period compared with natural loads in the creek (refer Section 8.5). Consequently, there will be no measurable change in water quality of the wetland. • Current operational pest management systems and procedures will apply to the Project. It is highly unlikely that any pest that could impact the ecological character of the wetland will be introduced by the Project, or spread if existing. • The modelling results from the air quality assessment (Appendix 6) predict that Project emissions (dust) will be below criteria levels beyond the RPA, therefore the values of Kakadu National Park will continue to be protected. <p>In conclusion and as outlined in Appendix 11, the multiple lines of evidence, physical, chemical and biological, acquired from the research and monitoring programs of the Supervising Scientist, ERA and others over the past 30 years, demonstrate no detrimental impact defined as, an impact which causes or is likely to cause a change to biodiversity or impairment of ecosystem health, during the operational phase of the Ranger mine.</p>

¹ Criterion sourced from DEWHA (2013).

The assessment of transport risks on Kakadu National Park provided in **Section 14.7.5** also applies to the Kakadu National Park Ramsar wetland. It can therefore be concluded that planned transportation activities associated with the Project are unlikely to have a significant impact on the Ramsar wetland, i.e. a wetland of importance.

Specific details of potential impacts from the Project on the individual ecological character values (critical components) for the Ramsar wetland are presented in **Table 14-10**.

Table 14-10: Assessment of potential impacts to the ecological character values of the Ramsar wetland

Critical components	Assessment of potential Project impacts on each critical component, process or service
C1 - Mangroves	<p>There will be no impact on this component as a consequence of the Project due to the distance from the tidal wetlands of the Kakadu National Park and the inherent design of the facility from a containment perspective.</p> <p>Mangrove forests represent approximately 7,200 ha (or around 3%) of the Park's coastal area (Russell-Smith 1995). The main threats to these existing mangrove communities are driven by climate change effects. The response of mangrove communities to these changes is uncertain (Bartolo, <i>et al.</i> 2008). Studies by Woodroffe (cited in Bartolo, <i>et al.</i> 2008, p. 90) examining responses to sea level rise indicate that a change to mangrove communities is anticipated. For mangroves, the rate of sea level rise is more important than a rise per se (Bayliss, <i>et al.</i> 1997). Woodroffe, (cited in Bartolo, <i>et al.</i> 2008, p. 91) further suggests that with potential inundation with sea water, mangroves are likely to opportunistically colonise areas such as the South Alligator River floodplain which would expand their current distribution.</p> <p>The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p> <p>The Project is unlikely to exceed the limits of acceptable change (number 1), in which mangrove extent declines by greater than 25% from baseline values outlined in BMT WBM (2010).</p>
C2 – <i>Melaleuca</i> forests	<p>A small area of vegetation (<1 ha) will be cleared from within, and adjacent, to a highly disturbed area on the RPA. This area does not include riparian areas of <i>Melaleuca</i> forest.</p> <p>The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p> <p>The Project is unlikely to exceed the limits of acceptable change (number 2) whereby:</p> <ul style="list-style-type: none"> • The number of <i>Melaleuca</i> trees at the Magela floodplain will not decline by greater than 50% of baseline values of (Riley & Lowry 2002) for the year 1996 (24 704 trees) (BMT WBM 2010).
C3 – Palustrine wetlands and billabongs	<p>The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p> <p>The Project is unlikely to result in a permanent loss of billabongs in the South Alligator River catchment as a direct result of anthropogenic changes in hydrological or geomorphological processes (number 3) (BMT WBM 2010).</p>

Critical components	Assessment of potential Project impacts on each critical component, process or service
C4 – Waterfalls, seeps and waterholes	<p>The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p> <p>The Project is unlikely to cause any instances of drying for perennial seeps and permanent waterholes, as per the limits of acceptable change (number 4) (BMT WBM 2010).</p>
C5 – Populations of migratory and resident waterbirds	<p>Evidence from Bayliss, <i>et al.</i> (2012) and Supervising Scientist (2013) indicates that risks from mine water contaminants to the Magela floodplain are an order of magnitude lower than non-mining landscape risks (e.g. aquatic weeds, feral pigs, cane toads, unmanaged dry season fires, and saltwater intrusion), and that existing Ranger operations have had no effect on aquatic ecosystems.</p> <p>The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p> <p>Based on an assessment of the potential impact of the Project on migratory species, the Project is considered unlikely to have a significant impact on migratory species at a regional or national scale. As noted in relation to threatened species, the Project involves clearing a small area within a substantially disturbed area. Although some migratory species are known to occur in the Magela LAA, the habitat values there are low, and the area beyond provides high quality habitat for a range of species (refer Appendix 12 – Habitat Values).</p> <p>There will be no change in the quality of surface water releases from the mine associated with the Project, as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality downstream.</p> <p>The Project is unlikely to impact on the limits of acceptable change (numbers 10, 11, 12, and 13) for waterbird abundance as outlined in (BMT WBM 2010).</p>
C6 – Populations of freshwater fish	<p>Surveys of the aquatic habitats of the RPA and surrounds have been conducted over more than 40 years, including the initial assessments conducted for the Fox Report⁹ in the 1970s (Fox, <i>et al.</i> 1977). More recent surveys have assessed the billabongs and associated riparian zones within the RPA and surrounds.</p> <p>Fish abundance was monitored by SSD in channel and shallow lowland billabongs on the RPA and in Kakadu from 1994 to 2012. For the channel billabongs, Mudginberri Billabong was compared to two control billabongs from independent catchments (Nourlangie Creek and Wirnmuyurr Creek); for the shallow lowland billabongs, three exposed billabongs (Georgetown, Coonjimba, and Gulungul) were compared to three control billabongs (Sandy, Buba, and Wirnmuyurr). Based on this monitoring it was concluded that changes to water quality downstream of Ranger mine as a consequence of mining during period of 1994 to 2012 had not adversely affected fish communities in both types of billabongs (Buckle &</p>

⁹ The Fox Report was the result of an enquiry by the Commonwealth government into the feasibility of uranium mining in the Alligator Rivers Region.

Critical components	Assessment of potential Project impacts on each critical component, process or service
	<p>Humphrey 2013).</p> <p>There will be no change in the quality of surface water releases from the mine associated with the Project, as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality downstream.</p> <p>The Project is unlikely to exceed the limits of acceptable change for freshwater fish abundance in billabongs (number 15), as outlined in BMT WBM (2010):</p> <p>The average abundance of freshwater fish species will not fall below the minimum recorded values of (Humphrey, <i>et al.</i> 2005) at both Sandy and Mudginberri Billabongs on more than 50% of sampling occasions over a 20 year period.</p>
C7 – Populations of freshwater and saltwater crocodiles	<p>The Project is unlikely to impact on local species' populations or reduce the area of habitat used by species. The Project will continue to use the existing water management system the outputs of which have been demonstrated to have no impact on the downstream receiving environment for 30 years of operations.</p> <p>The Project is unlikely to exceed the limits of acceptable change for the abundance of saltwater and freshwater crocodiles (numbers 16 and 17) (BMT WBM 2010):</p> <ul style="list-style-type: none"> • The average abundance of saltwater crocodiles will not fall below 35 000 individuals, which represents a 50% reduction in the 1994 estimated population. • The average abundance of freshwater crocodile will not fall below the minimum recorded values of Parks Australia on more than 50% of sampling occasions over a 20 year period.
C8 – Populations of threatened sharks	<p>The Project is unlikely to impact on local species' populations or reduce the area of habitat used by the species.</p> <p>The traffic impact assessment (Appendix 16) assessed risks to threatened and migratory species (including the spear-tooth shark and northern river shark) as identified under the EPBC Act and the Territory Parks and Wildlife Conservation Act. The assessment identified locations along the transport study corridor that are of greater environmental sensitivity to a spillage of consumables/product or associated with greater than average crash rates. The likelihood of impact on the two species was considered to be possible. However, there were no records of this species occurring within the study area.</p> <p>The Project is unlikely to exceed the limits of acceptable change for the spear tooth shark and northern river shark distribution and abundance (number 5) (BMT WBM 2010):</p> <ul style="list-style-type: none"> • The site continues to support spear-tooth shark in the long-term. • The Wildman and East, West and South Alligator Rivers continue to support northern river shark in the long-term.

Critical components	Assessment of potential Project impacts on each critical component, process or service
C9 – Yellow chat populations	<p>An assessment of potential Project impacts to populations of the yellow chat is described in Appendix 12. In summary, the Alligator Rivers yellow chat is restricted to floodplains from the Alligator River to the East Alligator River (DoE 2008). Yellow chats forage for insects within grasses, herbs and sedges and stands of mangroves, and aggregate around persisting wet areas at the end of the dry season (Woinarski & Armstrong 2006).</p> <p>A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of Kakadu National Park) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (Environment Australia 2012). Studies were conducted between 1994 and 2011, using a variety of methods.</p> <p>Surveys between 4 and 11 September 2013 conducted within the vent corridor and the surrounds incorporated area searches for this species, but no suitable floodplain habitat or yellow chats were recorded. A small area of vegetation (<1 ha) will be cleared from within, and adjacent, to the survey site. However, the Project is unlikely to impact on local species' populations or reduce the area of habitat used by species.</p> <p>The Project is unlikely to exceed the limits of acceptable change for the yellow chat (number 8), as outlined in BMT WBM (2010). The floodplain habitats of the site (Kakadu National Park) will continue to support the yellow chat in the long term.</p>
C10 – Pig-nosed turtles	<p>The Project is unlikely to impact on local species' populations or reduce the area of habitat used by species. The Project will continue to use existing water management system demonstrated to have no impact on the downstream receiving environment for 30 years of operations.</p> <p>The Project is unlikely to exceed the limit of acceptable change (number 6) (from (BMT WBM 2010)):</p> <ul style="list-style-type: none"> • Within the known core habitat of this species (as outlined in Georges and Kennett (1989)) the average density of pig-nosed turtle will not fall below 13.5 turtles/ha (30% reduction of minimum baseline value of 22.5 turtles/ha).
C11 – Locally endemic invertebrate species	<p>Macroinvertebrate communities have been sampled from different sites within the Magela Creek catchment at the end of the wet season, each year from 1988 to 2012. Upstream and downstream sites at two exposed (potentially impacted) streams (Gulungul and Magela Creeks) and two control sites (Burdulba and Nourlangie Creeks) were sampled. A dissimilarity index was used to measure the extent to which macroinvertebrate communities at the two sites differ. The evidence supports a conclusion that changes to water quality downstream of Ranger mine as a consequence of mining during the period 1994 to 2012 have not adversely affected macroinvertebrate communities (Humphrey, <i>et al.</i> 2013).</p> <p>There will be no change in the quality of surface water releases from the mine associated with the Project as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality downstream.</p> <p>The Project is unlikely to compromise the limits of acceptable change (number 9)</p>

Critical components	Assessment of potential Project impacts on each critical component, process or service
	<p>as outlined in BMT WBM (2010):</p> <ul style="list-style-type: none"> • As a minimum, sites at which each species has previously been recorded will continue to provide habitat for these species, unless it can be demonstrated that the species (i) can re-establish naturally and/or (ii) shows great variability in its presence within a site.
Critical processes	
P1 – Fluvial hydrology	<p>There will be no change in the quality or quantity of surface water releases from the mine associated with the Project as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality downstream.</p> <p>The amount of material that will be leached from backfill material placed in the underground mine on closure and subsequently report to Magela Creek via groundwater movement will be negligible over a 10,000 year period compared with natural loads in the Creek (refer Section 8.5). Consequently, there will be no measurable change in water quality downstream.</p> <p>The average annual volume of water that is likely to be generated by groundwater flowing into the underground over the life of the underground mine is 1.6 Mm³, as determined by modelling undertaken by INTERA (and described in Appendix 9). The mean annual discharge in Magela Creek is 382 Mm³ (see Section 8.3.2). If all inflowing water to the underground mine was added to Magela Creek via the surface water management system, this would represent a Project-derived increment of <0.5%. Given additional inflows to the creek from tributaries further downstream, this percentage would be lower if the Magela Creek floodplain were to be considered.</p> <p>The Project is unlikely to exceed the limits of acceptable change (number 18) (BMT WBM 2010):</p> <ul style="list-style-type: none"> • A greater than 20% change in the long-term mean annual flow constitutes an unacceptable change based on the following long-term average values: <ul style="list-style-type: none"> • East Alligator = 6.87 million ML/year • South Alligator = 5.75 million ML/year • West Alligator/Wildman = 0.815 million ML/year
P2 – Fire regimes	<p>ERA has a long term fire management strategy in place on the RPA, which is captured in ERA's five year fire management plan, implemented annually through a one year fire management plan. This strategy will minimise the risk of fire spreading into Kakadu National Park from the RPA, notwithstanding that approximately 55% of Kakadu National Park is burnt annually (refer Section 2.5.6).</p> <p>The Project is unlikely to exceed the limits of acceptable change for fire regimes (number 20), specifically:</p> <ul style="list-style-type: none"> • The area of wetland burnt per year within individual habitat types will not exceed maximum recorded baseline values outlined in Gill, et al. (2000) more

Critical components	Assessment of potential Project impacts on each critical component, process or service
	than twice over a 20 year period.
P3 – Breeding of waterbirds	<p>Evidence from Bayliss, <i>et al.</i> (2012) and Supervising Scientist (2013) indicates that risks from mine water contaminants to the Magela floodplain are an order of magnitude lower than non-mining landscape risks (aquatic weeds, feral pigs, cane toads, unmanaged dry season fires, and saltwater intrusion), that existing Ranger operations have had no effect on aquatic ecosystems.</p> <p>The Project will be managed in accordance with the Ranger mine's existing environmental management framework and is not expected to change the diversity or character of landscapes found within the Park (refer Section 14.5).</p> <p>There will be no change in the quality of surface water releases from the mine associated with the Project as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality downstream.</p> <p>The Project is unlikely to exceed the limits of acceptable change for critical life stage processes for waterbirds (number 19) (BMT WBM 2010):</p> <ul style="list-style-type: none"> • Based on expert opinion, the site no longer provides adequate refuge function for important flora and fauna species and populations; OR • Based on expert opinion, critical life-cycle processes identified in column 1 (e.g. known feeding sites, roosting sites, breeding sites, etc.) have either substantially diminished (in terms of frequency or extent of usage) or are otherwise no longer being supported (relative to natural variability).
P4 – Flatback turtle nesting	<p>The traffic impact assessment (Appendix 16) assessed risks to threatened and migratory species (including the flatback turtle) as identified under the EPBC Act and the Territory Parks and Wildlife Conservation Act. The assessment identified locations along the transport study corridor that are of greater environmental sensitivity to a spillage of consumables/product or associated with greater than average crash rates. The likelihood of impact on the flatback turtle was considered to be highly unlikely.</p> <p>The Project is unlikely to impact the limit of acceptable change for flatback turtle nesting (number 7) (BMT WBM 2010):</p> <ul style="list-style-type: none"> • The average number nesting attempts at core turtle nesting areas on Field Island, as measured over a one week period during the peak breeding period, must not fall below 0.8 attempts/night in three successive years (20% reduction in the minimum baseline value of one attempt a night during the peak breeding season).
Critical services/benefits	
S1 – Maintenance of global biodiversity	A comprehensive landscape ecological risk assessment of the Magela Floodplain focused on the protection of World Heritage environmental values. This assessment reached a conclusion that the point source risk from the operation of the Ranger mine was orders of magnitude lower than risks posed by weeds and

Critical components	Assessment of potential Project impacts on each critical component, process or service
	<p>feral animals (Jones 2008).</p> <p>Similarly, evidence from Bayliss, <i>et al.</i> (2012) and Supervising Scientist (2013) indicates that risks from mine water contaminants are an order of magnitude lower than non-mining landscape risks (aquatic weeds, feral pigs, cane toads, unmanaged dry season fires, and saltwater intrusion), that existing Ranger operations have had no effect on aquatic ecosystems and Ramsar wetlands and, in particular, the bioaccumulation of mine-derived contaminants in wetlands biota likely to be consumed by people from local and regional communities.</p> <p>The Project is unlikely to have an impact on the maintenance of global biodiversity, as per the limits of acceptable change 5, 6, 7, 8, and 9 in (BMT WBM 2010).</p>
S2 – Fisheries resource values	<p>Surveys of the aquatic habitats of the RPA and surrounds have been conducted over more than 40 years, including the initial assessments conducted for the Fox Report in the 1970s (Fox, <i>et al.</i> 1977). More recent surveys have assessed the billabongs and associated riparian zones within the RPA and surrounds.</p> <p>Fish abundance was monitored by SSD in channel and shallow lowland billabongs on the RPA and in Kakadu from 1994 to 2012. For the channel billabongs, Mudginberri Billabong was compared to two control billabongs from independent catchments (Nourlangie Creek and Wirnmuyurr Creek); for the shallow lowland billabongs, three exposed billabongs (Georgetown, Coonjimba, and Gulungul) were compared to three control billabongs (Sandy, Buba, and Wirnmuyurr). Based on this monitoring it was concluded that changes to water quality downstream of Ranger mine as a consequence of mining during period of 1994 to 2012 had not adversely affected fish communities in both types of billabongs (Buckle & Humphrey 2013).</p> <p>There will be no change in the quality of surface water releases from the mine associated with the Project as these releases will continue to be in accordance with the mine's water quality objectives that protect the downstream environment. Consequently, there will be no measurable change in water quality downstream.</p> <p>The Project is unlikely to affect the limit of acceptable change (14 and 15) whereby the average abundance of barramundi and other freshwater fish species falls below minimum recorded values for Sandy and Mudginberri Billabongs.</p>
S3 – Contemporary living culture	<p>The Project is unlikely to result in changes to the following indicators for the limit of acceptable change 21 (BMT WBM 2010):</p> <ul style="list-style-type: none"> • A greater than 10 percent reduction in the number of recorded sites due to preventable damage (e.g. human interference, feral animal damage, weathering, environmental degradation) • A greater than 10 percent reduction in the number of sites managed/maintained (outlined in the cultural database at Kakadu National Park Headquarters) due to preventable damage. <p>The Project is unlikely to impact on the above indicators as it is predominantly confined to within the RPA. The environmental studies have assessed and concluded that physical impacts (e.g. from air emissions, land clearing, etc.) are</p>

Critical components	Assessment of potential Project impacts on each critical component, process or service
	<p>predicted to be highly localised. Whilst there are associated transport activities, the results of an independent impact assess indicate there will be no material change to the risk profile.</p> <p>In addition, it is highly unlikely that there will be damage to representative and high priority sites as a result of the Project.</p> <p>BMT WBM (2010) states: "<i>Due to the lack of quantitative data regarding 'living culture' attributes, the limits of acceptable change are unable to be defined quantitatively.</i>" However, for limit of acceptable change 22, it is unlikely that the Project will affect the ability of Bininj to own, occupy, access and use the land and resources of Kakadu National Park, which could result in a loss of 'living culture'. It is also unlikely that the Project will result in a change in the ability of Bininj to use and transmit Bininj cultural practices, knowledge, language and spirituality could also result in a loss of 'living culture'.</p>

14.10 COMMONWEALTH LAND

Approximately 50% of Kakadu National Park is Aboriginal land under the Commonwealth *Aboriginal Land Rights (Northern Territory) Act 1976* (Aboriginal Land Rights Act). Most of the remaining area of land is under claim by Aboriginal people. Title to Aboriginal land in the Park is held by the Kakadu Aboriginal Land Trust, which has leased the land to the Director of National Parks (Australian Government), under the EPBC Act, for management of a Commonwealth reserve, i.e. national park. The remaining area of the Park is Commonwealth land vested under the Director of National Parks (BMT WBM 2010; Morse, *et al.* 2005). SEWPaC (2013) states that Commonwealth land includes land owned or leased by the Commonwealth, or a Commonwealth agency, and land that is included in a Commonwealth reserve.

Ranger mine is located on land belonging to the Kakadu Aboriginal Land Trust and ERA has agreed access in accordance with the Aboriginal Land Rights Act. Therefore, no Commonwealth land will be directly impacted by the Project; however, downstream and indirect impacts may occur as described in **Sections 14.7.3** and **14.9.3**. The potential for these impacts to affect Commonwealth land is assessed in **Table 14-11**.

Table 14-11: Assessment of impacts on Commonwealth land

Impact criterion ¹	Assessment of Project impact
Impacts on landscapes and soils	
Is there a real chance or possibility that the action will:	
<ul style="list-style-type: none"> Substantially alter natural landscape features 	No (refer Section 14.7.5)
<ul style="list-style-type: none"> Cause subsidence, instability or substantial erosion 	Underground mine and paste backfill design will not result in surface subsidence. Pit 3 walls will not be destabilised as a pillar will be retained between Pit 3 and the Ranger 3 Deeps underground mine (refer Chapter 15).
<ul style="list-style-type: none"> Involve medium or large-scale excavation of soil or minerals 	Excavation of materials will occur within the RPA, which is not on Commonwealth land.
Impacts on coastal landscapes and processes	
Is there a real chance or possibility that the action will:	
<ul style="list-style-type: none"> Alter coastal processes, including wave action, sediment movement or accretion, or water circulation patterns 	Not applicable; RPA is located approximately 90 km from the coast, the connecting pathway being via Magela Creek and its floodplain, and the East Alligator River.
<ul style="list-style-type: none"> Permanently alter tidal patterns, water flows or water quality in estuaries 	
<ul style="list-style-type: none"> Reduce biological diversity or change species composition in estuaries 	
<ul style="list-style-type: none"> Extract large volumes of sand or substantially destabilise sand dunes 	
Impacts on ocean forms, ocean processes and ocean life	
Is there a areal chance or possibility that the action will:	
<ul style="list-style-type: none"> Reduce biological diversity or change species composition on reefs, seamounts or in other sensitive marine environments 	Not applicable; RPA located approximately 90 km from coast.
<ul style="list-style-type: none"> Alter water circulation patterns by modification of existing landforms or the addition of artificial reefs or other large structures 	
<ul style="list-style-type: none"> Substantially damage or modify large areas of the seafloor or ocean habitat, such as sea grass 	
<ul style="list-style-type: none"> Release oil, fuel or other toxic substances into the marine environment in sufficient quantity to kill larger marine animals or alter ecosystem processes 	

Impact criterion ¹	Assessment of Project impact
<ul style="list-style-type: none"> Release large quantities of sewage or other waste into the marine environment 	
Impacts on water resources	
Is there a real chance or possibility that the action will:	
<ul style="list-style-type: none"> Measurably reduce the quantity, quality or availability of surface or groundwater 	No (refer Section 14.7.5).
<ul style="list-style-type: none"> Channelise, divert or impound rivers or creeks or substantially alter drainage patterns 	
<ul style="list-style-type: none"> Measurably alter water table levels 	
Pollutants, chemicals and toxic substances	
Is there a real chance or possibility that the action will:	
<ul style="list-style-type: none"> Generate smoke, fumes, chemicals, nutrients or other pollutants which will substantially reduce local air quality or water quality 	No (refer Section 14.7.5).
<ul style="list-style-type: none"> Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport or disposal 	ERA will continue to implement stringent management measures for the transport, storage, use and disposal of hazardous materials (refer Chapters 3 and 12).
<ul style="list-style-type: none"> Increase atmospheric concentrations of gases which will contribute to the greenhouse effect or ozone damage 	Greenhouse gas emissions will increase with the Project (refer Section 6.5).
<ul style="list-style-type: none"> Substantially disturb contaminated or acid-[sulfate] soils 	Acid sulfate soils within the Magela Creek floodplain will not be disturbed by the Project.
Impacts on plants	
Is there a real chance or possibility that the action will:	
<ul style="list-style-type: none"> Involve medium or large-scaled native vegetation clearance 	No, <1 ha of vegetation will be cleared for the Project (refer Section 14.5.4 and Section 14.7.5).
<ul style="list-style-type: none"> Involve any clearance of any vegetation containing a listed threatened species which is likely to result in long-term decline in a population or which threatens the viability of the species 	No threatened species were identified in the vegetation that will be cleared or in the vicinity (refer Section 14.3.3).
<ul style="list-style-type: none"> Introduce potentially invasive species 	Current operational pest management systems and procedures will apply to the Project. It is unlikely that any pest that could impact on plant species. (refer Section 14.5.4).

Impact criterion ¹	Assessment of Project impact
<ul style="list-style-type: none"> Involve the use of chemicals which substantially stunt the growth of native vegetation 	ERA will continue to implement stringent management measures for the transport, storage, use and disposal of hazardous materials (refer Chapters 3 and 12).
<ul style="list-style-type: none"> Involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species 	No (refer Section 14.7.5)

¹ Criterion sourced from (SEWPaC 2013).

The Mount Bunday military training area (refer **Section 14.8**) is located downstream of the RPA and Kakadu National Park and upstream of the transport route along the Arnhem Highway, and is therefore too distant to be impacted by the Project.

As outlined in the sections above, the environmental controls built into the design of the Project, and the implementation of existing and additional mitigation measures, will provide for the ongoing overall protection of the surrounding environment, including land outside the RPA, i.e. Kakadu National Park (Commonwealth land) and the more distant Mount Bunday military training area.

14.11 PROTECTION OF THE ENVIRONMENT FROM NUCLEAR ACTIONS

This EIS has assessed the potential risks associated with extracting uranium ore, via underground mining methods, from the Ranger 3 Deeps resource at Ranger mine. Each of the risk chapters has identified the main risks and described how risks will be mitigated to protect the environment. Drawing on 30 years of operational experience that has demonstrated the feasibility and successful implementation of management systems (mitigation measures), and supplementing these measures with additional controls, it can be concluded that:

- For all substances modelled, the Project does not exceed relevant health and visual amenity air quality criteria at residential, cultural and ecological receptors. Similarly, modelled combined (existing operations and the Project) concentrations of substances are predicted to be below these criteria, with the exception of NO₂, which currently predicts that levels may exceed the maximum 1 hour NO₂ air NEPM criteria when certain meteorological conditions are present (**Section 6.4.7**).
- The predicted noise level increase associated with the Project at the nearest residential and public receptors will be insignificant. The occasional fauna disturbance noise criteria will be exceeded at ecological receptors in the near vicinity of the Project due to the combined effect of the existing and predicted noise levels, and noise sensitive species are expected to temporarily relocate to lower noise areas (**Section 6.6.7**).

- Surface vibration associated with the ventilation raise construction and underground mine development is predicted to be either negligible or undetectable at all receptor locations (**Section 6.7.7**).
- Predicted radiation doses to workers will not exceed the annual limit. Similarly, estimated Project radiation doses to the public from both inhalation of radon and dusts and ingestion of bush foods are very low as the cumulative dose (from existing operations and the Project) are less than 10% of the public dose limit (**Section 7.5**).
- The Project is not expected to adversely impact downstream water quality or hydrology due primarily to the effectiveness of Ranger mine's current water management system and its capacity to absorb changes resulting from the Project. Impacts on the beneficial uses associated with Magela Creek and its wetlands are therefore also expected to remain unaffected by the Project (**Chapter 8**).
- Developing the Project within a disturbed area (mostly within the existing operational footprint) will limit vegetation clearance to < 1 ha. The effects of airborne dust, noise, vibration, radiation and managed water release from the Ranger mine are not expected to cause significant impacts to higher quality habitat and threatened/migratory species that are more distant to the Project and beyond the RPA (**Section 9.6**).
- The scale of surface disturbance associated with the Project will not add to the existing potential risk of damage to cultural heritage sites. Air quality modelling and vibration monitoring has demonstrated that the Project will have no measurable effect on cultural heritage sites (**Section 10.5**).
- The Project will provide sustained financial payments to Traditional Owners and presents an opportunity to continue social programs to address indigenous socio-economic disadvantage (**Section 11.3.7.1**).
- The Project will provide sustained financial and social investment in Jabiru, However, the long-term future of the town once Ranger mine closes remains a concern for stakeholders, regardless of Project-related impacts (**Section 11.3.7.2**).
- The Project has the potential to contribute to existing social issues in the Alligator Rivers Region, e.g. substance abuse, violence and other forms of anti-social behaviour (**Section 11.3.7.3**).
- The Project does not materially alter the existing transport risk profile. Potential impacts to the environment relate to unplanned events, i.e. abnormal operating conditions. The consequence of an event that could impact flora, fauna and environmental values could be major; however, the likelihood of the event occurring is rare (**Section 12.9**).

14.12 SUMMARY

The assessment of risks to MNES and Commonwealth land considers ERA's 30 year history of successfully minimising impacts on the surrounding environment. The mitigation measures described to protect flora and fauna, surface water and groundwater, and cultural heritage values are based on ERA's experience and existing environmental controls and systems and have been demonstrated to be feasible and successfully implemented. This will minimise risks to the environment within, and beyond, the RPA, as summarised in **Section 14.11**. The Project, therefore, is unlikely to cause significant impacts to MNES or Commonwealth land.

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