



Appendix I

Biodiversity Management Plan





TNG Limited
Mount Peake Project
Biodiversity Management Plan

March 2017

Document Status

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1. Introduction

1.1 Purpose

The Mount Peake Project (the Project) involves activities during construction and operations that have the potential to have an impact on biodiversity. The purpose of this Biodiversity Management Plan (BMP) is to describe the processes required for mitigating and monitoring the impacts of Project activities on biodiversity, including:

- Avoiding injury to or death of native fauna resulting from Project activities
- Minimising the disturbance of native vegetation
- Minimising impacts on rare or threatened species
- Adopting impact-minimising procedures during vegetation clearing, including wildlife rescue
- Managing weeds and feral animals, including predators and vermin.

Construction and operation activities that will potentially have an impact on biodiversity include:

- Clearing of vegetation
- Hot works and other potential sources of planned and/or unplanned fire
- Vehicle movements, leading to collisions between fauna and traffic
- Transporting, storing and using hazardous substances
- Groundwater drawdown through operation of the borefield
- Weed management and site reinstatement, which, if inadequate, could lead to introduction and/or spread of weeds
- Management of putrescible waste, which, if inadequate, could lead to an increase in population size of non-native (cat, fox) and native predators (dingo) via increases in introduced vermin species such as House Mouse and Black Rat.

This BMP forms part of the Environmental Management Plan and is a working document. It was updated in February 2017 following additional site investigations (threatened species targeted survey, November 2016) and following review of the draft EIS by the Northern Territory Environment Protection Authority (NT EPA), other government agencies and stakeholders. When new information is obtained the BMP will be updated (e.g. new records of threatened species, demonstrated inadequacy of mitigation measures).

TNG will manage the potential impacts on biodiversity in accordance with this BMP.

1.2 Objectives

The objectives of the BMP are to:

- Identify the key biodiversity issues that require control measures and monitoring
- Develop and implement strategies to manage and minimise impacts on biodiversity
- Establish a biodiversity monitoring program to evaluate Project impacts and the efficacy of mitigation efforts
- Assign responsibilities for management of potential impacts and implementation of mitigation measures
- Provide sufficient information to assist audits of the BMP implementation.

1.3 Legislation, Guidelines, Recovery Plans and Threat Abatement Plans

The legislation and guidelines relating to the management of biodiversity at the Project site are:

- Legislation
 - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth)
 - *Bushfires Management Act 2016* (NT)
 - *Environmental Offences and Penalties Act 1996* (NT)
 - *Mining Management Act 2011* (NT)
 - *National Environment Protection Council (Northern Territory) Act 1994* (NT)
 - *Territory Parks and Wildlife Conservation Act* (TPWC Act) 2013 (NT)
 - *Weeds Management Act 2001* (NT).
- Guidelines
 - Northern Territory Survey Methods for Flora and Fauna Surveys Used for Standard Biodiversity Unit Survey Sites
 - Survey Guidelines for Australia's Threatened Mammals. EPBC Act Survey Guidelines 6.5
 - Survey Guidelines for Australia's Threatened Reptiles: Guidelines for Detecting Reptiles Listed as Threatened Under the EPBC Act.
- Recovery Plans
 - National Recovery Plan for the Greater Bilby (*Macrotis lagotis*)
 - A Recovery Plan for the Great Desert Skink (*Egernia kintorei*) – Note: *Egernia kintorei* is a taxonomic synonym for *Liopholis kintorei*
 - Recovery Plan for Five Species of Rock Wallabies: Black-Footed Rock Wallaby (*Petrogale lateralis*), Rothschild Rock Wallaby (*P. rothschildi*), Short-Eared Rock Wallaby (*P. brachyotis*), Monjon (*P. burbidgei*) and Nabarlek (*P. concinna*) 2012-2022.
- Threat Abatement Plans
 - Threat Abatement Plan for Predation by Feral Cats
 - Threat Abatement Plan for Predation by the European Red Fox
 - Threat Abatement Plan for Competition and Land Degradation by Rabbits
 - Threat Abatement Plan to reduce the Impacts on Northern Australia's Biodiversity by the Five Listed Grasses.

1.4 Previous Investigations

This BMP has been prepared from biodiversity information obtained from the EIS studies. A summary of previous ecological and biodiversity investigations is provided in Table 1-1.

Table 1-1 Summary of biodiversity investigations relevant to the study area

Date	Reference	Description
9 – 14 April 2013	GHD 2015	Flora and vegetation baseline survey across the study area
9 -14 April 2014	GHD 2015a	Fauna baseline survey across the study area
21 – 24 November 2016	GHD 2017a	Targeted threatened species surveys for Greater Bilby, Great Desert Skink, Brush-tailed Mulgara
21 – 24 November 2016	GHD 2017b	In-fill vegetation survey to incorporate revised Project footprints and the groundwater drawdown cone of the borefield.

2. Existing Conditions – Biodiversity requiring management

2.1 Bioregion

The Project area is located within the Burt Plain Bioregion which is characterised by plains and low rocky ranges with extensive areas of mulga and other acacia woodlands. The bioregion covers an area of 73,605 square kilometres, which represents approximately 5% of the Northern Territory (NRETAS 2005).

Previously identified potential and existing threats to biodiversity in the bioregion include the introduction and proliferation of introduced flora and fauna, fire, erosion, land clearing, pastoralism and mining (Neave *et al.* 2006).

There are fifteen declared weed species currently listed under the NT Weeds Management Act that are known to occur within the bioregion. Other exotic plant species, most notably Buffel and Couch grass, also pose significant threats to some habitats (Neave *et al.* 2006).

2.2 Flora and Vegetation

2.2.1 Survey

An assessment of flora and vegetation was undertaken in April 2013 as part of the EIS process (GHD 2015). The survey targeted the mine site, mine camp, 1 km-wide corridor along the initially proposed alignment of the access road and Adnera Loadout Facility. The location of flora surveys across the Project area is provided in Figure 2-1.

Additional vegetation surveys covering areas not previously surveyed, such as the borefield delivery pipeline and access road and borrow pits were undertaken in November 2016 (GHD 2017b).

Flora survey techniques used were consistent with the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst *et al.* 2007) and included:

- Quadrats
- Check sites
- Aerial surveys
- Opportunistic collections
- Vegetation mapping.

A summary of survey results is provided below.

2.2.2 Results

The fine-scale vegetation mapping identified eight broad vegetation communities within the Project area. The dominant vegetation types to be impacted by the Project are:

- Mulga shrublands, which occur on alluvial fans and plains containing clayey red earths
- Triodia hummock grasslands which grow on sandy plains and undulating hills
- Riparian woodland along watercourses and drainage channels within the predicted groundwater drawdown cone for the borefield.

Vegetation is generally in good condition with little anthropologic disturbance and high species richness. In more fertile riparian areas and associated floodplains there is clear evidence of impacts associated with cattle grazing including weed invasion, reduction in ground cover species and soil erosion. In particular, there is a high abundance of the invasive grass *Cenchrus ciliaris* (Buffel Grass).

Vegetation communities within the study area are detailed in Table 2-1.

Table 2-1 Vegetation communities within the study area

Veg. Code	Vegetation Type	NVIS Description (Level III Broad Floristic Formation)
VT 1	Low open Eucalyptus woodland on limestone	Triodia hummock grassland
VT 2	Mulga shrubland on sandy red earths	Acacia shrubland
VT 3	Riparian woodland along watercourses and drainage channels	Eucalyptus open woodland
VT 4	Low <i>Corymbia</i> woodland on loamy alluvial plains	Tussock grassland
VT 5	Floodplains dominated by <i>Eucalyptus victrix</i>	Eucalyptus open woodland
VT 6	Triodia grassland on sandy plains	Triodia hummock grassland
VT 7	Low Acacia shrubland on rocky slopes	Triodia hummock grassland
VT 8	Tall Acacia shrubland on stony quartz	Acacia shrubland

Flora

The NT Government flora records for the study area (plus a 20 km buffer) contain 1,392 records of 494 species. These records include one threatened flora species, the Dwarf Desert Spike Rush (*Eleocharis papillosa*), listed as vulnerable under both the TPWC Act and the EPBC Act.

Database records for the locality included 1 vulnerable species, 7 near threatened species¹, 6 endemic species and 13 species recorded as being data deficient². Table 2-2 provides a list of vulnerable, threatened and data deficient species previously recorded in the locality. Sixteen exotic species have also been recorded within the locality.

The site survey identified 238 flora species (233 native and five introduced). Habitat for the Dwarf Desert Spike Rush (*Eleocharis papillosa*) was identified but no individuals were present. Similarly, targeted searching across parts of the study area identified no individuals of Giant Sweet Potato (*Ipomoea polpha* subsp. *latzii*). The Department of Land Resource Management (DLRM) Dwarf Desert Spike-Rush fact sheet is provided in Appendix B.

No threatened flora species were recorded during the survey.

¹ Under IUCN criteria this conservation category is defined as taxa that do not meet the criteria for Critically Endangered, Endangered or Vulnerable at present but is close to qualifying for or is likely to qualify for a threatened category in the near future.

² Under IUCN data deficient taxa are defined as species where there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.

Table 2-2 Threatened flora species

Name		Conservation Status		Number of records within locality
Scientific	Common	TPWC	EPBC	
<i>Eleocharis papillosa</i>	Dwarf Desert Spike Rush	V	V	5
<i>Goodenia cylindrocarpa</i>	-	dd	-	3
<i>Lawrencia viridi-grisea</i>	-	dd	-	2
<i>Brachyscome ciliaris</i>	Variable daisy	dd	-	13
<i>Ectrosia schultzei</i> var. <i>schultzei</i>	-	dd	-	3
<i>Acacia oswaldii</i>	Umbrella Wattle	dd	-	4
<i>Acacia incurvaneura</i>	-	dd		2
<i>Acacia pteraneura</i>	Mulga	dd		1
<i>Eriachne</i> sp <i>Davernport Ranges</i>		dd		3
<i>Triumfetta chaetocarpa</i>	Urchins	dd	-	2
<i>Triumfetta deserticola</i>		dd		1
<i>Ixiochlamys nana</i>		dd		2
<i>Peplidium foecundum</i>		dd		1
<i>Swainsona acuticarinata</i>		dd		1
<i>Bulbostylis pyrifolmis</i>		nt		1
<i>Ipomoea polpha</i> subsp. <i>latzii</i>	Giant Sweet Potato	nt	-	11
<i>Gymnanthera cunninghamii</i>	-	nt	-	-
<i>Osteocarpum salsuginosum</i>	-	nt	-	1
<i>Sclerolaena densiflora</i>	-	nt	-	1
<i>Spartothamnella puberula</i>		nt		2
<i>Trianthema flossostigma</i>		nt		2

Notes: V = vulnerable
dd = data deficient
nt = near threatened

Weeds

Weeds can be categorised according to the areas they colonise and the types of threat they pose. Several different categories of weeds (noxious weeds, environmental weeds, Weeds of National Significance (WONS), unlisted common weeds) are recognised at a national, state and local level. A summary of classified weeds (WONS and/or NT *Weed Management Act*) and environmental weeds from database records and those identified onsite are provided in Table 2-3.

Table 2-3 Summary of weeds

Common	Name	Classification					Presence	
	Scientific	WONS	Class A	Class B	Class C	Env	Bioregion ^A	Project ^B
Athel Pine	<i>Tamarix aphylla</i>			✓	✓		✓	
Bathurst Burr	<i>Xanthium spinosum</i>			✓	✓		✓	
Buffel Grass	<i>Cenchrus ciliaris</i>					✓		✓
Bitter Melon	<i>Citrullus lanatus</i>					✓		✓
Caltrop	<i>Tribulus terrestris</i>			✓	✓		✓	✓
Castor Oil Plant	<i>Ricinus communis</i>			✓	✓		✓	
Coffee Senna	<i>Senna occidentalis</i>			✓	✓		✓	
Elastic Grass	<i>Eragrostis tenuifolia</i>					✓		✓
Khaki Weed	<i>Alternanthera pungens</i>			✓	✓		✓	
Mesquite, Algaroba	<i>Prosopis pallida</i>	✓	✓		✓		✓	
Mimosa Bush	<i>Vachellia farnesiana</i>					✓		✓
Mossman River Grass	<i>Cenchrus echinatus</i>			✓	✓		✓	
Noogoora Burr	<i>Xanthium strumarium</i>			✓	✓		✓	
Parkinsonia	<i>Parkinsonia aculeata</i>	✓		✓	✓		✓	
Patterson's Curse	<i>Echium plantagineum</i>		✓		✓		✓	
Prickly Pears – Devil's Rope Pear	<i>Opuntia</i> spp. – <i>Opuntia imbricata</i>			✓	✓		✓	
Rubber Bush	<i>Calotropis procera</i>			✓	✓		✓	
Saffron Thistle	<i>Carthamus lanatus</i>			✓	✓		✓	
Thornapples – Native Thornapple	<i>Datura</i> spp – <i>Datura leichhardtii</i>			✓	✓		✓	
Total		2	2	13	15	3	15	5

Notes: ^A Sourced from Neave *et al* 2006.
^B Sourced from GHD April 2013 survey data.
WONS: Weed of National Significance

2.3 Terrestrial fauna

2.3.1 Baseline Survey

An assessment of fauna was undertaken in April 2013 as part of the EIS process (GHD 2015a). The survey targeted the mine site, mine camp, 1 km wide corridor along the proposed alignment of the access road, and the Adnera Loadout Facility.

The fauna assessment utilised an initial desktop assessment of potential fauna species at the site including the Commonwealth Department of the Environment (DoE) Protected Matters Search Tool (PMST) and Department of Land Resource Management (DLRM) Fauna Atlas database.

The onsite fauna survey techniques used were consistent with the Guidelines for assessment of impacts on terrestrial biodiversity (NT EPA 2013) and *Territory Parks and Wildlife Conservation Act* permit issued to GHD by the NT Parks and Wildlife Commission (Permit number 40623, expiry date 30 April 2014). The survey included the following techniques:

- Sixteen 50 x 50m trapping quadrats (each containing 20 baited Elliot-type traps, 4 baited cage traps, 4 pitfall buckets and 12 funnel traps), 8 bird surveys per site, anabat ultrasonic call recordings at each site and 3 diurnal and two nocturnal active searches per site
- Sampling undertaken in Mulga Woodland (x 8 sites), Rocky Shrubland (x 3), Spinifex (x 2), Riparian Woodland (x 2) and *Corymbia* Woodland (x 1)
- Remote surveillance cameras located at five sites
- Habitat assessment at each site
- Scat/hair/bone/skin/scat samples collected opportunistically across the study area
- Opportunistic observations of all fauna across the study area.

2.3.2 Targeted Threatened Species Survey

During the April 2013 baseline survey, a number of fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified as being present or potentially present in the Study Area. These species included:

- Black-footed Rock-wallaby (*Petrogale lateralis lateralis*) (MacDonnell Ranges Population)
- Greater Bilby (*Macrotis lagotis*)
- Great Desert Skink (*Liopholis kintorei*).

Based on the April 2013 survey results, fauna desktop assessment and the Terms of Reference (TOR) set by the NT EPA for assessment of the Mount Peake Project, additional targeted threatened species survey work was required to obtain sufficient information on potential impacts of the Project on the threatened species listed above.

A targeted survey for threatened fauna species (focussing on the Greater Bilby, Black-footed Rock-wallaby and Great Desert Skink and their habitats) was completed in November 2016. The assessed area focussed on areas of the access road alignment where the relevant species were considered most likely to occur, and was informed by the desktop and site-visit findings of the 2013 fauna survey. The survey comprised a four-day survey of the current alignment of the access road, including intensive walking transects over 25 km, and an area of 300-375 ha.

The assessed area and the location of fauna survey sites across the Project area in 2013 and 2016 are provided in Figure 2-2 and Figure 2-3 respectively. A summary of survey results (2013 and 2016 combined) is provided below.

2.3.3 Results

All fauna – baseline survey

As reported in GHD (2015a), the DotE PMST and the NT Fauna Atlas database identify that 280 fauna species are known or predicted to occur within the vicinity of the Project. The majority of these species are native to the Northern Territory including 40 mammals, 145 birds, 74 reptiles and nine amphibians (268 in total).

The April 2013 baseline survey resulted in the identification of 116 fauna species within the Project area, including 24 mammals, 58 birds and 34 reptiles (no amphibians were detected).

Eighteen species detected during the survey had not previously been recorded on databases for this area. These include 11 native species of mammal (one dunnart and 10 insectivorous bats), three native species of bird and four native species of reptile.

Threatened Species – baseline and targeted survey results

The DLRM Fauna Atlas and the PMST results identified 22 threatened or near-threatened species vertebrate fauna species (15 mammals, 6 birds and one reptile) for the Study Area. Twenty of these are listed under the EPBC Act and all are listed under NT legislation (TPWC Act). Some of the species (all mammals) are considered extinct in the Northern Territory, and others are predicted to occur but have never before been recorded within the Burt Plains Bioregion.

Sixteen threatened or near-threatened species (six mammals, six birds, three reptiles and one frog) are considered likely to occur within the Study Area, either as residents or visitors. Many of these are expected to be rare or very rare. Eight of the threatened species were detected in or around the Project area during the baseline fauna survey in April 2013, and three were detected during the targeted survey in November 2016, as shown in Table 2-4. The locations of sightings or suspected sightings are shown in Figure 2-2 and Figure 2-3.

Table 2-4 Threatened fauna considered for this Biodiversity Management Plan, and observations made during 2013 or 2016 surveys.

Name		Status		April 2013	November 2016
Common	Scientific	EPBC	TPWC		
Mammals					
Black-footed Rock-wallaby (MacDonnell Ranges Race)	<i>Petrogale lateralis</i>	VU	NT	Possible observation in broader area from helicopter	Not observed
Greater Bilby	<i>Macrotis lagotis</i>	VU	VU	Possible diggings/scratchings observed in suitable habitat	Not observed
Brush-tailed mulgara	<i>Dasycercus blythi</i>	-	VU	At least one active burrow recorded	Not observed
Common Brushtail Possum (Southern NT)	<i>Trichosurus vulpecula vulpecula</i>	-	EN	Not observed	Not observed
Birds					
Grey falcon	<i>Falco hypoleucos</i>	-	VU	Observed once	Not observed
Reptiles					
Great Desert Skink	<i>Liopholis kintorei</i>	VU	VU	Not observed	Observed at one location.

Species listed as Near Threatened (NT) or Data Deficient (DD) under the TPWC Act are not considered to be threatened species, so are not considered for specific management actions in this BMP. Also, two threatened species of bird identified in GHD (2015a) as 'possible' to occur within the Project area are not considered here for the management plan (Princess Parrot, *Polytelis alexandrae*, and Night Parrot, *Pezoporus occidentalis*). Those species are likely to be very rare visitors to the Project area, if they occur there at all.

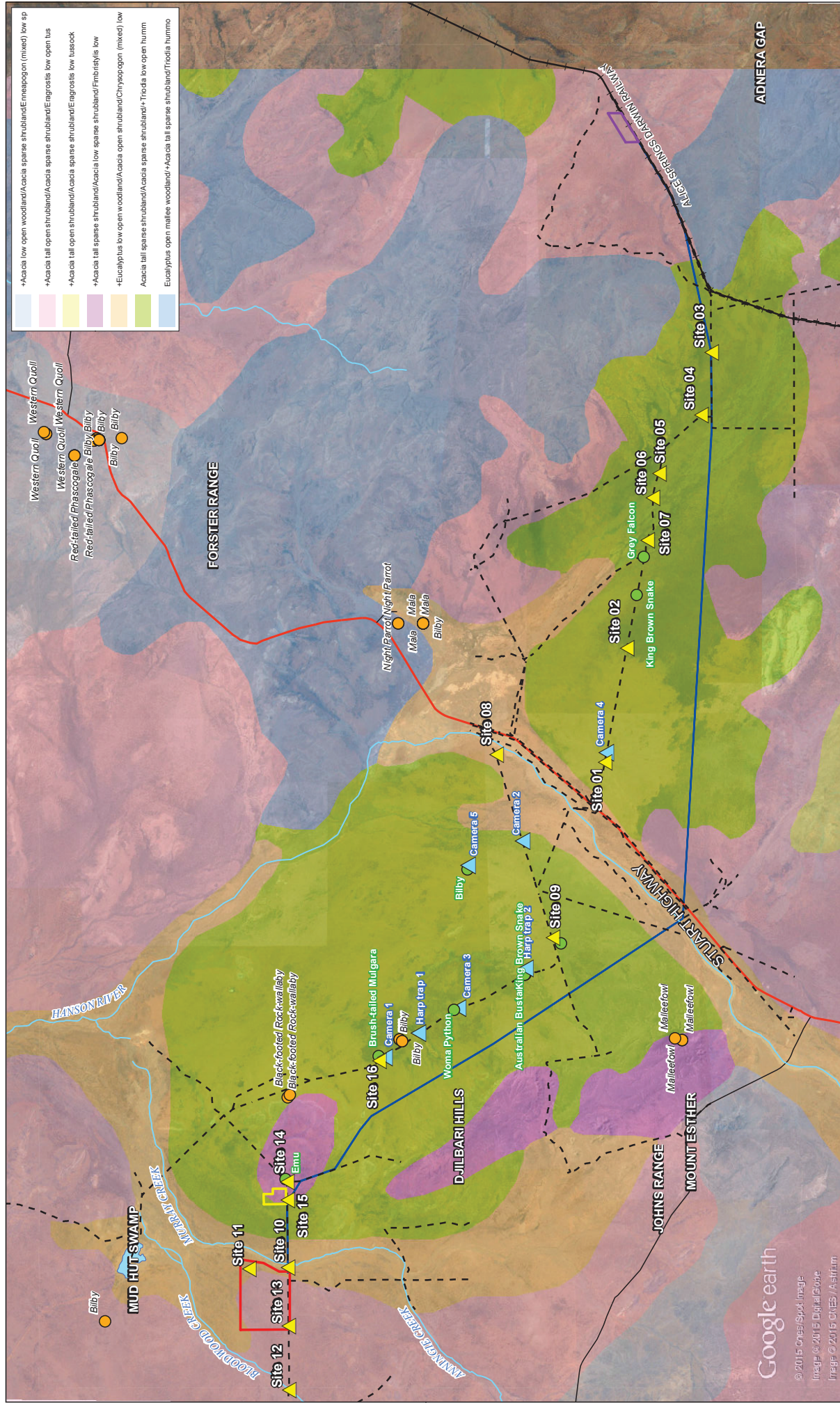


**Figure 2-2
Fauna Site Locations**

GHD Threatened Fauna Records
LRM Threatened Species

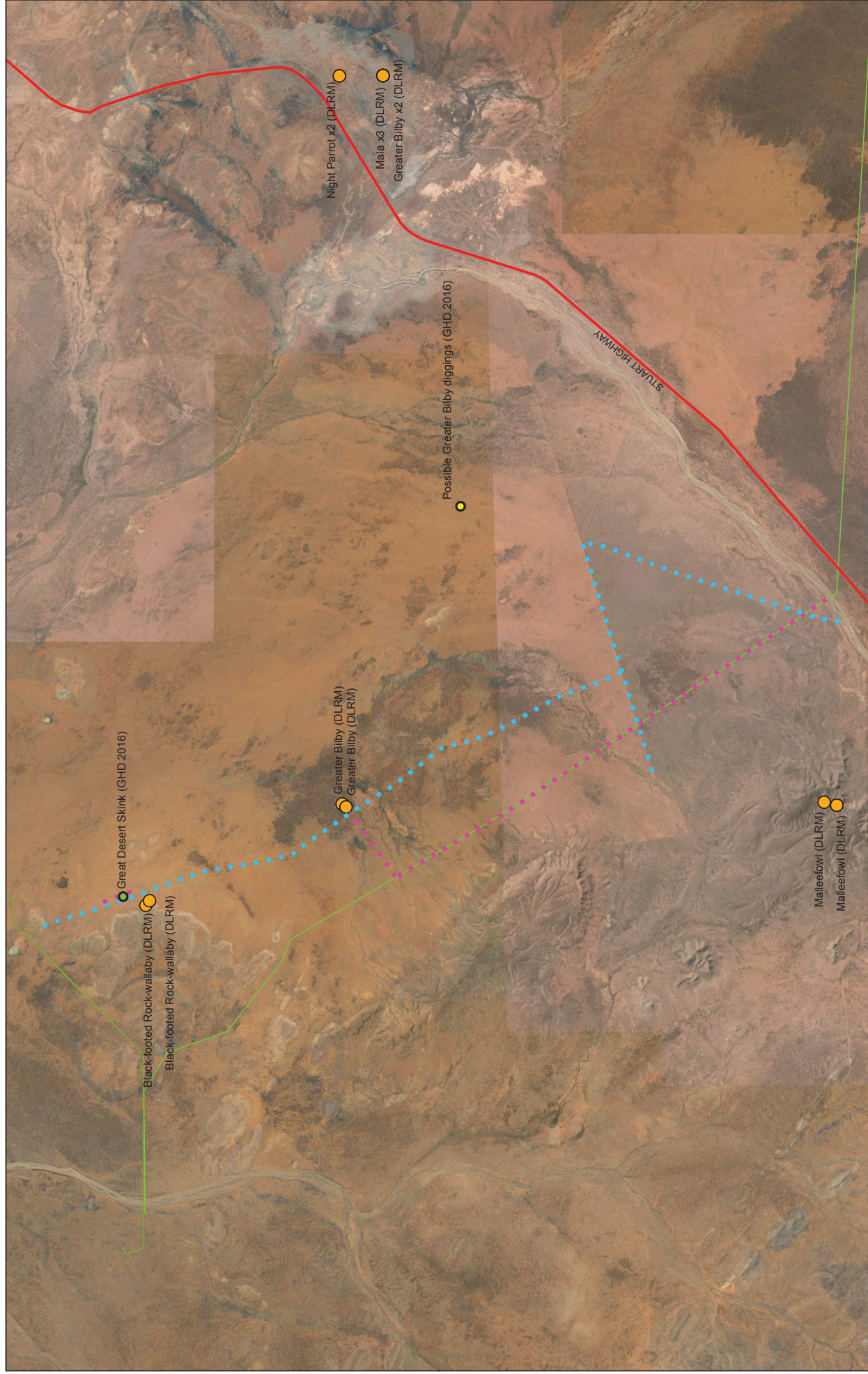
Map Projections: UTM Zone 53
Horizontal Datum: GDA, 1994
Grid: GDA 1994 MGA Zone 53

Mercator
Mercator

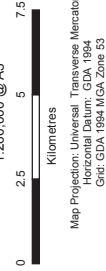
Min or Road

Hud Swamp

Mud Swamp



1:260,000 @ A3



LEGEND
Major Roads

Proposed Infrastructure Alignment

DLRM Database records as labelled

2016 Survey Walking Transect
2016 Survey Driving Transect

Great Desert Skink observation 2016
Possible Greater Bilby diggings 2013

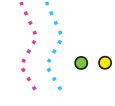


Figure 2-3

**Targeted Threatened Species
Fauna Surveys**

TNG Limited
Mount Peake EIS
Job Number 61-29057
Revision A
Date 09 Dec 2016

The Black-footed Rock-wallaby was not detected within the Project area during the April 2013 or November 2016 fauna surveys, but its presence in the nearby Djilbari Hills was confirmed by a GHD ecologist during a helicopter flight for vegetation mapping in April 2013. While there is a small chance of individual rock-wallabies dispersing occasionally through the Project area from one rocky outcrop to another, the likelihood of this Project having a measurable impact on this species is considered to be very low. Consequently, this species is included in the risk assessment for this BMP, but no specific management actions for this species are proposed in this BMP. Additional mitigation may be required for this species if rock-wallabies are injured or killed as a result of the Project (the most likely source of impact is wildlife-vehicle collisions along roads between rocky outcrops).

The Greater Bilby was not observed at any stage despite extensive targeted searches of all areas of potentially suitable habitat along the proposed access road alignment. However, diggings were found 11 km from the proposed impact areas in April 2013, and were potentially made by Bilby. Confidence in these diggings being made by Bilby was reasonably high (J. Kuiper, GHD Ecologist; pers. comm.; Formerly with Australian Wildlife Conservancy). Therefore, the presence of Greater Bilby in the broader region is considered possible. This determination is made on the basis of these possible diggings and areas of potentially suitable spinifex sandplain habitat containing witchetty bush (*Acacia kempeana*) particularly along the proposed alignment, apparent intent of the diggings (i.e. targeting a food source of termites and/or shallow roots), the appearance and characteristics of the scratchings (e.g. sharp edge to scrapes, two or three obvious claws marks), and proximity to historical Greater Bilby records. Despite its presence in the Project area not being confirmed, management actions for the Greater Bilby are proposed in this BMP.

The Brush-tailed Mulgara was not observed, but was considered likely to be present based on indirect signs (burrows, diggings and scratchings). Our confidence in the identification of mulgara burrows is high – the burrows seen were fresh and active, and showed the characteristic signs of a burrow of this species (as experienced by GHD zoologists in other surveys of the Burt Plain area of the NT, where live animals have been photographed using camera traps at potential burrows). Failure to detect a live animal at the burrow using a remote sensing camera may indicate relatively low abundance of the species at this site, but may also be explained by the species' known sensitivity to disturbance, and the likelihood that mulgaras have numerous burrow entrances that would be used preferentially in response to disturbance. As for the Greater Bilby, management actions for the Brush-tailed Mulgara are proposed in this BMP, despite its presence in the Project area not being confirmed.

A single Great Desert Skink (*Liopholis kintorei*) was observed fleetingly on a cool and cloudy morning during the November 2016 survey, at the edge of an access track in open sandplain within spinifex (*Triodia spp.*) understorey, approximately 7 km from the proposed access road. Subsequent searches of the area surrounding the sighting failed to detect any further signs of this species, such as communal burrow systems or latrines. Management actions for the Great Desert Skink are proposed in this BMP.

The Common Brushtail Possum was not observed during any site assessment. However, it has the potential to use eucalypt-dominated riparian habitats along the Hanson River, which may be impacted by groundwater drawdown, so is considered for this BMP.

Based on the survey effort of the 2013 and 2016 assessments, observations of suitable habitat features, and advice and field assistance from local specialist ecologists from Desert Wildlife Services, the failure to detect a live Bilby or Mulgara, and observation of only a single Great Desert Skink and no burrows, suggests that none of these species is likely to be present in large numbers within the Study Area. However, arid fauna typically have breeding strategies that allow them to respond rapidly to improving conditions. Thus, future population sizes may differ greatly from current population sizes, and the value of potentially suitable habitat cannot be overstated.

Aside from the rock-wallaby, the threatened species detected are species that have broad distributions across Australia. The narrowest distributions are those of the two mammal species (Bilby and Mulgara), whose distributional ranges have declined in recent decades, most likely in response to a combination of predation by feral cats, habitat disturbance and degradation due to grazing, weed invasion, and increased use of fire across the landscape.

Ground-dwelling species (reptiles, non-volant mammals, flightless birds) that have limited mobility across the landscape are perhaps most at risk from localised habitat changes that may result from construction and operation of a mine in the Study Area.

DLRM fact sheets for threatened species are provided in Appendix C.

Migratory Species

Seven bird species predicted or known to occur within the Project area are listed as Migratory under the EPBC Act (Table 2-5). The rainbow bee-eater (*Merops ornatus*) is the only one for which there are historical records for the Project area in the DLRM Fauna Atlas, and this species was detected in relatively small numbers during the 2013 and 2016 surveys.

Table 2-5 EPBC Act-listed migratory fauna species identified for the Project area

Name		Identifying Entity		
Common	Scientific	DLRM	PMST	GHD
Birds				
Fork-tailed Swift	<i>Apus pacificus</i>		✓	
Great Egret	<i>Ardea alba</i>		✓	
Cattle Egret	<i>Ardea ibis</i>		✓	
Oriental Plover	<i>Charadrius veredus</i>		✓	
Australian Painted Snipe	<i>Rostratula australis</i>		✓	
Oriental Pratincole	<i>Glareola maldivarum</i>		✓	
Rainbow Bee-eater	<i>Merops ornatus</i>	✓	✓	✓

Feral / Pest animals

Twelve non-native fauna species were observed in the Project area during the surveys, including ten mammals, one bird and one reptile. A summary of non-native fauna species identified in the PMST and Fauna Atlas database and those observed onsite are provided in Table 2-6.

Table 2-6 Non-native fauna species identified for the Project area

Name		Identifying Entity		
Common	Scientific	DLRM	PMST	GHD
Mammals				
Cat	<i>Felis catus</i>	✓	✓	✓
European Rabbit	<i>Oryctolagus cuniculus</i>	✓		✓
Donkey	<i>Equus asinus</i>	✓		✓
Dog (domestic)	<i>Canis lupus familiaris</i>		✓	
House Mouse	<i>Mus musculus</i>	✓	✓	
Red Fox	<i>Vulpes vulpes</i>		✓	
Horse	<i>Equus caballus</i>	✓		
Pig	<i>Sus scrofa</i>	✓		
Cattle	<i>Bos taurus</i>	✓	✓	✓
Camel	<i>Camelus dromedarius</i>		✓	
Birds				
Rock Dove	<i>Columba livia</i>	✓	✓	
Reptiles				
Asian House Gecko	<i>Hemidactylus frenatus</i>	✓	✓	

3. Biodiversity Management

3.1 Approach

For the purposes of this document, biodiversity management refers to flora, vegetation (excluding weeds) and wildlife (fauna) within the Project area. Weeds will be managed through the Weed Management Plan.

Management of biodiversity is structured as follows:

- **Key Activities, Risks and Impacts:** Identification of the key activities being undertaken during the management period, and the potential environmental impacts and residual risk levels for each environmental aspect
- **Objectives:** Definition of the guiding environmental management objective(s) and activities that apply to the element
- **Mitigation Measures:** Description of the procedures to be employed to enable relevant objectives to be met
- **Responsibility:** Nominates the responsible person/position for implementing actions and monitoring
- **Trigger, Action, Response Plan (TARP):** Identifies the actions to be implemented in the case of non-compliance. This includes strategies of remediation and the person(s) responsible for the actions.

These components of biodiversity management are described in more detail below.

3.2 Key Activities, Risks and Impacts

The key activities and potential environmental risks and impacts identified for biodiversity are listed in Table 3-1. The residual risk level identified is the risk remaining after management and mitigation measures are implemented. The risk matrix used for this assessment is provided in Appendix E.

Table 3-1 Key activities, risks and impacts for fauna and flora

Activity	Potential Environmental Impact	Residual Risk Level		
		Consequence	Likelihood	Risk
Fauna				
Clearing of habitat; Fragmentation of habitat.	- Reduction of extent of fauna habitat. - Adverse impact on habitat critical to the survival of a species. - A long-term reduction in rare, endemic or unique fauna populations or species. - Modification, destruction, removal or isolation of habitat availability or quality such that a threatened species is likely to decline.	Greater Bilby, Brush-tailed Mulgara, Great Desert Skink	2	2
		Black-footed Rock-wallaby, Grey Falcon, Common Brushtail Possum	1	2
Alteration to surface water flows caused by construction of roads, hard stands or embankments; Contamination of surface water bodies; Erosion and sedimentation.	- Fragment or damage habitat important for the conservation of biological diversity. - Modify or inhibit ecological processes. - Reduce the species diversity. - Fragment or damage habitat important for the conservation of biological diversity. - Cause a long term reduction in rare, endemic or unique population or species.		1	2
			1	2
Lowering or contamination of water table.	- Reduce species diversity. - Cause a reduction in a population. - Fragment or damage habitat important for the conservation of biological diversity	Black-footed Rock-wallaby, Grey Falcon	1	1
		Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Common Brushtail Possum	1	2
Production, transport and storage of mine waste.	- Injury and death of fauna as a result of increase in waste-carrying transport and resulting collisions with wildlife. - Clearing of breeding and/or foraging habitat to create space to store/pile waste products. - Dust as a result of increased traffic and specifically due to haulage of waste rock.	Black-footed Rock-wallaby, Common Brushtail Possum	2	2
		Greater Bilby, Brush-tailed Mulgara, Great Desert Skink	1	3
		Grey Falcon	1	1
Production and management of putrescible/non-mineralised waste.	- Increase in vermin (rats and mice). - Increase in predators (cats, foxes and dingoes). - Cause a reduction in a population.	Black-footed Rock-wallaby and Common Brushtail Possum	2	1
		Greater Bilby, Brush-tailed Mulgara, Great Desert Skink	2	2
		Grey Falcon	1	1
Noise from Project activities.	- Modify or inhibit ecological processes. - Reduce the diversity or modify the composition of fauna communities.	Black-footed Rock-wallaby, Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Common Brushtail Possum	1	2

Activity	Potential Environmental Impact	Residual Risk Level		
		Consequence	Likelihood	Risk
	Cause a long term reduction in rare, endemic or unique fauna species.	1	1	VL
Dust from Project activities.	- Modify or inhibit ecological processes. - Reduce the diversity or modify the composition of fauna species. - Cause a long term reduction in rare, endemic or unique fauna species.	1	2	VL
Light from Project activities.	- Reduce the diversity or modify the composition of fauna species. - Cause a long term reduction in rare, endemic or unique fauna species.	1	2	VL
Planned or unplanned wildfire.	- Long-term decrease in the size of a population. - Reduce the area of occupancy of the species. - Adversely affect habitat critical to the survival of the species. - Fragment an existing population into two or more populations. - Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. - Interfere with recovery of the species.	4	2	M
	Black-footed Rock-wallaby, Greater Bilby, Brush-tailed Mulgara, Great Desert Skink, Common Brushtail Possum			
	Grey Falcon	1	2	VL
Impacts from vehicles/transport.	- Injury and death of fauna as a result of collisions with wildlife. - Dust as a result of increased traffic and haulage of waste rock. - Long-term decrease in the size of a population. - Interfere with recovery of the species. - Cause a long term reduction in rare, endemic or unique fauna species.	1	1	VL
	Black-footed Rock-wallaby, Common Brushtail Possum			
	Greater Bilby, Brush-tailed Mulgara, Great Desert Skink	1	2	VL
	Grey Falcon	2	1	L
Introduction of weed species to site and / or spread of existing weeds into new areas (this includes through inappropriate or ineffective rehabilitation).	- Modify or inhibit ecological processes. - Reduce the diversity or modify the composition of fauna species. - Fragment or damage habitat important for the conservation of biological diversity. - Cause a long term reduction in rare, endemic or unique fauna species. - Fragment, isolate or substantially damage habitat for rare, endemic or unique fauna species.	2	3	M
Poisoning of fauna from drinking contaminated water.	- Long-term decrease in the size of a population. - Interfere with recovery of the species. - Cause a long-term reduction in rare, endemic or unique fauna species.	1	1	VL
Flora and Vegetation				
	Adverse impact on habitat critical to the survival of a species or community.	3	1	L

Activity	Potential Environmental Impact	Residual Risk Level		
		Consequence	Likelihood	Risk
Construction activities requiring the clearance of native vegetation.		4	1	M
Wind erosion mobilising dust from exposed surfaces, such as pits, waste dumps, tailings storage facility, laydown areas, stockpiles, roads and sites of vegetation clearing; Drilling, blasting, excavation and materials handling at the mine site during operations results in dispersion of particulates and dust.	- Fragment or damage habitat important for the conservation of biological diversity. - Cause a long-term reduction in rare, endemic or unique plant populations or species. - Modification, destruction, removal or isolation of habitat availability or quality such that a threatened species or community is likely to decline. - Increased likelihood of weed establishment in cleared areas. - Dust deposition leading to disturbance / loss of general terrestrial flora species and vegetation communities. - Modify or inhibit ecological processes - Reduce the diversity or modify the composition of plant species. - Cause a long-term reduction in rare, endemic or unique plant populations or species.	3	2	M
		2	2	L
Removal of individuals or habitat for the threatened flora species Dwarf Desert Spike Rush.	Decrease in the population size of a listed threatened species.	4	1	M
		4	1	M
Unplanned wildfire.	- Modify or inhibit ecological processes. - Reduce the species diversity or modify the composition of plant communities. - Fragment or damage habitat important for the conservation of biological diversity. - Cause a long-term reduction in rare, endemic or unique plant populations or species.	2	2	L
Alteration to surface water flows caused by construction of roads, hard stands or embankments.	- Modify or inhibit ecological processes. - Reduce the species diversity or modify the composition of plant communities. - Fragment or damage habitat important for the conservation of biological diversity. - Cause a long-term reduction in rare, endemic or unique plant populations or species.	4	1	M
		2	3	M
Lowering of the water table caused by groundwater extraction.	- Cause a long-term reduction in rare, endemic or unique plant populations or species. - Disturbance to significant vegetation and flora within Mud Hut or Stirling Swamp. - Reduce the species diversity or modify the composition of plant communities (i.e. Riparian communities or Swamp Vegetation within Annaterr North SOCS). - Cause a reduction in the population of Dwarf Spike Rush at Stirling Swamp. - Fragment or damage habitat important for the conservation of biological diversity. - Impact on phreatophytic vegetation in the area of borefield groundwater drawdown. - Disturbance to significant vegetation and flora within Annaterr North SOCS. - Disturbance of vegetation along Hanson River. - Destruction of flora and vegetation.	4	1	M
		2	2	L
		2	4	M
Contamination of surface and/or groundwater caused by erosion and sedimentation, hydrocarbon or chemical spills		3	1	L
		3	3	M
Failure of TSF.		3	1	L

3.3 Objectives

Biodiversity management objectives are detailed in Table 3-2.

Table 3-2 Flora and fauna management objectives

Objective	Target	Indicator
Establish and maintain awareness and importance of protecting biodiversity across the Project.	All onsite personnel (including Contractors) to undertake site induction, which will include a summary of the Project's biodiversity values.	Percentage of personnel who complete the site induction.
Minimise extent of vegetation clearance and undertake clearance in accordance with the Ground Disturbance Permit system.	Zero clearing outside agreed Project footprint and approved borrow pit locations.	Number of incidents of clearing outside approved clearance areas and extent of clearing outside approved clearance areas.
Avoid injuring or killing native fauna by road collision or during clearing.	Zero incidents of native fauna injury or death from Project activities. All drivers adhering to established Project speed limits.	Number of native fauna injury or death from Project activities.
Implement system for the management of injured and dead fauna.	Zero additional incidents from roadkill. Injured fauna to be reported to the Environmental Manager to manage and/or to contact Wild Care Alice Springs.	Number of incidents occurring as a result of roadkill. Percentage of injured fauna incidents resolved and/or managed in unison with Wild Care Alice Springs.
Implement Pest Animal Monitoring Plan (Cat, Fox and Dingoes, rats, mice, rabbits).	For feral predators: No change in the feral cat/fox population and no more than a 50% increase in the dingo population. For vermin: No vermin hotspots (i.e., locations where vermin multiply to large numbers, thereby potentially attracting predators).	Percentage increase in predator population sizes. Reports of vermin (rats, mice, rabbits)
Minimise the incidence and impact of fire resulting from Project activities.	No unplanned wildfire resulting from Project activities. No planned fires escaping.	Area unintentionally burnt as a result of Project activities.

3.4 Mitigation Measures

Mitigation measures have been developed to minimise potential impacts on flora and fauna. The mitigation measures, timing and responsibilities are described in Table 3-3.

Table 3-3 Mitigation measures

ID	Mitigation Measure	Purpose/Objective	Timing	Responsibility
Site Induction				
FF1	Site induction will include the following components for biodiversity management: - Summary of biodiversity values at the Project including threatened flora and fauna that do or may occur in the Project area (threatened species information cards are located in Appendix C) - Details of construction activities that could impact on flora and fauna - Description of procedure to follow if fauna is injured or killed through Project activities, including removal of roadkill at least 10 m from road - Requirement to enter and exit site through recognised vehicle access points only, and to utilise only existing/approved roads and tracks within the Project area - The need to obey speed limits across the Project area - The need for areas to be cleared to be flagged and approved through a Ground Disturbance Permit System (Appendix D).	Raise awareness of threats to biodiversity. Educate personnel on ways to avoid impacts. Educate personnel on procedure to follow in the event of vehicle injuring or killing fauna.	Prior to work commencing	All personnel
General				
FF2	Application of industry accepted erosion and sediment control, including: - Installation of erosion and sediment control measures prior to construction - Regular inspection of erosion and sediment control measures, particularly following rainfall events, to ensure their ongoing functionality - Runoff from disturbed and rehabilitated areas diverted into sediment ponds and not discharged directly into the natural system - Constructing adequate bunds around potential contamination sources, to contain contaminated water in the event of heavy rainfall.	Minimise erosion. Minimise sedimentation (e.g. of waterways).	Construction and operation	Site Manager
FF3	Application of industry accepted dust control measures, including: - Road wetting, covering of exposed loads where practicable and maintaining moisture levels in bulk loose construction materials - Minimising hauling and vehicle travel in conditions when wind strength results in spatially extensive and heavy dust deposition in surrounding habitats - Reduced vehicle speeds for high-use areas/roads - Progressive reinstatements of cleared land as activities are completed. Areas which have previously been disturbed will be used before areas that require additional vegetation clearance.	Reduce dust impacts.	At all times	Construction and Site Manager
FF4	Management of weeds in the Project area in accordance with industry accepted weed control measures (presented in a Weed Management Plan).	Minimise impacts to fauna habitats.	At all times	Construction and Site Manager
FF5		Minimise impacts to fauna habitats and vegetation condition.	At all times	Construction and Site Manager

ID	Mitigation Measure	Purpose/Objective	Timing	Responsibility
FF6	Management of hazardous substances in accordance with the industry accepted standards (as written in a Hazardous Substances Management Plan).	Minimise impacts to surrounding habitats	At all times	Construction and Site Manager
FF7	Management of fire in accordance with the Fire Management Plan.	Minimise impacts to threatened fauna	At all times	Construction and Site Manager
FF8	Management of non-mineralised waste in accordance with the Non-mineralised Waste Management Plan.	Minimise impacts to surrounding habitats	At all times	Construction and Site Manager
FF9	Management of groundwater drawdown in accordance with a Water Management Plan and Borefield Management Plan (to be produced).	Minimise impacts to GDEs	At all times	Construction and Site Manager
FF10	Concentrate loads covered to prevent dust generation and product loss.	Reduce dust impacts	Operation	Site Manager
FF11	Seal/cover open holes, pits, trenches (e.g. monitoring bores, production wells, exploration bores) when not manned to prevent ground-dwelling fauna from falling in.	Reduce impacts to fauna	At all times	All personnel
FF12	Develop and implement a Traffic Management Plan.	Minimise impacts to threatened fauna	Prior to construction.	TNG Management Team
Clearing of vegetation				
FF13	Prior to clearing, a Ground Disturbance Permit is required to be issued by the Environmental Manager. The system is to be developed prior to the construction phase and will comply with the information outlined in Appendix D.	Obtain authorisation	At all times	Environmental Manager
FF14	Minimise ground disturbance at all locations and specifically at riparian zones and within the Anmatyerr North Site of Conservation Significance (SOCS).	Reduce impacts to SOCS and habitats of the Project area	At all times	Construction and Site Manager
FF15	Large-scale vegetation clearing or earthworks will be undertaken during autumn as far as possible.	Minimise impacts to breeding/hibernating fauna and recently independent fauna	At all times	Construction and Site Manager
FF16	Clearing of firebreaks surrounding infrastructure will be undertaken in accordance with the Fire Management Plan.	Minimise risk of destructive wildfire	At all times	Construction and Site Manager
FF17	Clearly mark areas of land to be cleared and areas to be retained (No-Go areas), so that impacts do not extend any further than necessary into important habitat.	Minimise impacts to surrounding habitats	Prior to clearing during all phases of the Project	Area Managers
FF18	Clear vegetation areas progressively and incrementally as needed, rather than large-scale clearing in advance.	Stage the impacts on fauna habitat, allowing more opportunity for fauna to move to other areas	At all times	Area Managers
FF19	Consider applying a cool, well-managed fuel-reduction burn to all habitats to be cleared (but not beyond) immediately prior to clearing, to encourage fauna to flee prior to clearing. The specifics of fuel-reduction burns are to be determined in consultation with relevant stakeholders prior to fires being lit.	Encourage fauna to move out of areas identified for clearing	Prior to clearing	HSEC Manager, in collaboration with NT DLRM and local stakeholders

ID	Mitigation Measure	Purpose/Objective	Timing	Responsibility
FF20	Qualified ecologist will be present during clearing of sandplain habitats where mulgara burrows have been mapped, to oversee careful removal of burrows and to capture/translocate animals unable to escape, if found.	Move fauna out of harm's way	During clearing	HSEC Manager, using qualified ecologists
Noise				
FF21	Limit high-impact noise (e.g. blasting) to daylight hours as far as possible.	Reduce impacts on nocturnal fauna.	At all times	Area Manager
Light				
FF22	Incorporate light reduction during the detailed design phase including: - Limit artificial light to areas where it is essential; - Turn off lights when not required; - Avoid the flood of light into natural habitats and limit the escape of light into surrounding areas of fauna habitat (i.e. using shields/deflectors); - Ensure that artificial lighting is not directed upwards or laterally (i.e. direct lights towards the ground); - Use lower (i.e. closer to the ground) rather than higher lighting installations; - Use lower wavelengths of light wherever possible i.e. red/yellow lights; - Use light intensities that are as low as possible without reducing safety or efficiency; - Avoid painting large structures bright or reflective colours and minimise use of bright or reflective construction materials and finishes for large structures.	Reduce impacts on nocturnal fauna, including bats (which are attracted to insects around lights).	At all times	Area Managers
Unplanned Wildfire				
FF23	Carefully plan and identify where and when high-risk activities can take place.	Minimise risk of wildfire.	As required	Area Managers
FF24	Establish or maintain adequate fire breaks around high-risk areas/activities.	Minimise risk of wildfire.	At all times	Area Managers
FF25	Implement active fire management, using localised cool-season control burns within 100 m of mine activities and roads to reduce fuel loads.	Minimise risk of wildfire.	As required	HSEC Manager, in collaboration with NT DLRM and local stakeholders
Pest animals				
FF26	As part of the management of putrescibles/domestic waste (garbage), implement sound waste management to limit invasion/colonisation by introduced vermin such as <i>Rattus rattus</i> and <i>Mus musculus</i> and access by introduced predators (fox, cat) and native predators such as the dingo.	Minimise potential impacts of vermin and pest predators, which may increase in population size.	At all times	Environmental Officer

ID	Mitigation Measure	Purpose/Objective	Timing	Responsibility
FF27	General site waste will be managed to prevent/reduce interaction with fauna. Waste management includes: - Regular covering of landfill contents; - Fencing installed around the landfill to restrict interaction with fauna; - Storage of waste in vermin-proof bins with secure lids, before waste is moved to landfill; - Keep waste oils and/or hazardous substances in sealed containers and/or covered.	Avoid population increase in pest predators (which may increase their numbers on vermin, but also incorporate native fauna in their diet).	At all times	Area Managers
FF28	Implement a Pest Monitoring Plan to monitor feral cat and fox populations (and dingo, if it becomes overabundant) to determine if control measures are required. The plan is summarised in Table 4-2.	Minimise potential impacts of pest predators	Timing and frequency to be determined by results of pest-animal monitoring	Area Managers
Surface and Groundwater				
FF29	Reduce attractiveness (to wildlife) of the Tailings Storage Facility, Sediment Basins and Process Water Ponds through the implementation of Best Practice Guidelines for Reducing Impacts of Tailings Storage Facilities on Avian Wildlife (DME 1998).	Minimise impacts on fauna.	Design, construction and operational phases	Area Manager
FF30	Fence off tailings storage facility to prevent ground-based fauna from accessing the water.	Minimise impacts on fauna.	Construction	Area Manager
FF31	Seal or cover monitoring bores, production wells and exploration bores to prevent fauna entering.	Minimise impacts on fauna	At all times	Area Manager
Haulage and Vehicle Movement				
FF32	Keep the proposed road network to a minimum and upgrade and utilise existing vehicle tracks. Ensure that all vehicles travel on these designated roads, and not on secondary or short-cut roads/tracks.	Minimise impacts on fauna.	Design, construction and operational phases	Area Managers
FF33	Implement and enforce speed restriction controls for all roads across the entire Project area.	Minimise impacts on fauna.	Construction and operational phases	Area Managers
FF34	Implement reduced speed limits for all vehicles at night (i.e., dusk til dawn) in sensitive habitat areas, to reduce the likelihood and incidence of roadkill.	Minimise impacts on fauna	Construction and operational phases	Area Managers
FF35	Upgrade high-use areas to be safer for vehicles and fauna (e.g. no blind curves, wider shrub-free verges).	Minimise impacts on fauna.	Design and construction phases	Area Managers
FF36	If injured fauna is encountered, assess the situation and potential requirement to euthanize and/or contact Wild Care Alice Springs for advice: - M: 0419 221 128 - E: wildcareasp@gmail.com	Minimise impacts on fauna.	Construction and Operation	All personnel; Environmental Officer

ID	Mitigation Measure	Purpose/Objective	Timing	Responsibility
FF37	If dead animals are found on/beside roads, the Environmental Officer is to be notified immediately to remove the carcass a minimum of 20 m into adjacent land to prevent subsequent collisions with scavenging animals. Environmental Officer will establish a Register (see Appendix A) to document location, date, time of day and species, to understand collision 'hotspots', which can then be modified as required (signage, diversion fencing) to further reduce the risk.	Minimise impacts on fauna.	Construction and Operation	All personnel Environmental Officer
Rehabilitation				
FF38	Areas not required for ongoing operations will be progressively rehabilitated with local provenance native flora species.	Effective rehabilitation	At all times	Construction and Site Manager
FF39	Topsoil will be stripped and stockpiled in a designated area, to prevent erosion or run-off.	Topsoil available for reinstatement	At all times	Construction and Site Manager
FF40	As far as possible, seeds collected for the rehabilitation program will be sourced locally (e.g. within a 20 km radius of the Project area). If insufficient seed is available from the area, then seed of local provenance will be sourced where possible.	Local provenance seed used in rehab	At all times	Construction and Site Manager
FF41	Management and monitoring of vegetation rehabilitation will be undertaken in accordance with the Project's Rehabilitation Plan.	Rehab managed and monitored effectively	At all times	Construction and Site Manager
Inspection and Monitoring				
FF42	The distribution and size of arid fauna populations can vary with conditions, such that threatened species populations occur in the Project area. Threatened species monitoring in sandplain habitats within the Project area is required periodically, as detailed in Table 4-5.	Determine Projects impact on threatened species.	Every two years, then annually if Greater Bilby, Brush-tailed Mulgara, or Great Desert Skink are detected	Environmental Officer, with monitoring to be conducted by qualified ecologists
FF43	Monitoring of pest species is required to determine if additional measures are required. A Pest Monitoring Plan is detailed in Table 4-2.	Determine Projects impact on pest species.	Annual	Environmental Officer
FF44	Management of pest animals is required in accordance with the Pest Animal Management Plan detailed in Table 4-3.	Bait and trapping to remove known pests.	Continual	Environmental Officer
FF45	Monitor impacts of groundwater drawdown on phreatophytic vegetation at the borefield as detailed in Table 4-6.	Quantify impacts	Prior to Borefield operation and then during operation.	Environmental Officer
FF46	Daily assessment of compliance with Ground Disturbance Permits.	Ensure adherence to permit conditions	Daily	Environmental Manager
FF47	Annual Biodiversity Management Plan performance review (audit) including assessment of fauna sightings, incidents and ground disturbance permit approval performance.	Determine effectiveness of BMP implementation	Annual	Environmental Manager, with audit to be conducted by external party with no vested interest in Project.

3.5 Trigger, Action and Response Plan

The Trigger, Action and Response Plan (TARP) outlines remedial actions and responses required for three escalating situation levels for: i) vegetation clearance and ii) fauna observations or incidents. The TARP is provided in Table 3-4.

Table 3-4 Trigger, Action and Response Plan

Biodiversity value affected	Responsibility	Situation		
		Normal	Level 1	Level 2
Vegetation		Site activities managed in accordance with mitigation measures with no incidents.	Areas of vegetation outside Project boundary or existing disturbance proposed for clearance.	Vegetation cleared from outside approved boundary.
	Site Personnel	Comply with: - Site Induction requirements. - Personnel, Vehicle and Equipment Hygiene Procedures. - Ground Disturbance Permit Procedures.		Stop work and inform the Environmental Manager of additional disturbance.
	Environmental Manager	Undertake regular walkovers / inspections of work areas.	Assess requirement to clear outside Project boundary. Areas to be cleared outside existing disturbance will be flagged to prevent over-clearing. Ensure topsoil and seed bank are managed and stored appropriately to facilitate successful rehabilitation. Survey additional disturbance Implement erosion and sediment control measures.	Survey additional disturbance. Ensure erosion and sediment control measures in place are adequate. Sign/fence the unapproved clearing area as a no-go zone. Investigate the causes and reasons behind how the additional disturbance occurred, and provide to Construction and/or Site Manager. Initiate rehabilitation of additional disturbance.
	Construction and Site Manager	Ensure the Biodiversity Management Plan is being implemented by all Site Personnel.		Assess the ground disturbance incident and undertaken relevant management measures to restore the area and prevent recurrence.
Fauna		Fauna observed outside work area. Fauna behaving normally.	Native fauna observed in the construction and/or operational activity areas. Fauna behaviour abnormal/stressed	Native fauna injured or killed due to Project activities.
	Contractor	Continue to operate diligently and remember the site induction flora and fauna components. Monitor fauna movements to see that fauna don't enter works area.	Stop work if fauna is within harm's way. Encourage or wait for native fauna to vacate works areas, without harming animal. Report sighting to the Site Manager.	Report incident to Site Manager for entry into Fauna Sighting and Fatality Register (Appendix A). (information required: location, date, time of day, type of animal (species), how incident occurred). If fauna is killed by collision with vehicle, move carcass from road at least 20 m into adjacent bush land to prevent subsequent collisions with scavenging fauna.

Biodiversity value affected	Responsibility	Situation		
		Normal	Level 1	Level 2
	Environmental Officer	-	Enter sighting into Fauna Sighting and Fatality Register (Appendix A).	- For injured fauna, assess situation and potential requirement to euthanize and/or contact Wild Care Alice Springs for advice: M: 0419 221 128 E: wildcareasp@gmail.com - For dead fauna killed on road, ensure carcass moved at least 20 m from road into adjacent land. - Record incident in Fauna Sighting and Incident Register (Appendix A). Determine if species is a threatened species and if the death activates the need for additional mitigation measures. If threatened species, record as an environmental incident. If threatened species and carcass in reasonably good condition, retain and freeze carcass and contact NT Museum or DLRM. Carcass may be of value to science.
	Area Manager	Ensure the Biodiversity Management Plan is being implemented appropriately by all Site Personnel.		Assist Environmental Manager in implementing additional mitigation measures to prevent recurrence, if required.

4. Monitoring and Threat Abatement Program

4.1 Purpose and Approach

Biodiversity monitoring is required during the course of the construction and operation to ensure that mitigation efforts are adequately protecting biodiversity as intended, and to be able to respond to new threats to biodiversity (particularly threatened species) which may arise with changing conditions.

Programs will be established in ways that allow results from monitoring surveys to be compared with established baseline information. If monitoring indicates that the current mitigation efforts are inadequate, then revised or increased mitigation measures will be implemented to protect biodiversity.

So that the monitoring efforts remain effective and worthwhile (i.e. not monitoring for the sake of monitoring), priority is given to trying to detect:

- increases in populations of pest animal species (vermin and pest predators)
- decreases in known populations of threatened species
- the presence or increased abundance of threatened species that may have been recorded as 'absent' or in very small numbers in the Project area during the assessments, but that are known to undergo large fluctuations in different environmental conditions and that may occupy or colonise suitable habitat in the Project area during the course of the Project
- Changes in mapped GDE areas.

4.2 Commonwealth Threat Abatement Plans

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), threat abatement plans establish a national framework to guide and coordinate Australia's response to key threatening processes. The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by key threatening processes. Threat abatement plans directly relevant to fauna for this Project include:

- Threat abatement plan for predation by European red fox – 2008
- Threat abatement plan for predation by feral cats – 2015.

Threatened species considered to be at high risk of predation by feral Cat and/or Red Fox do or may occur within the Project area (e.g. Black-footed Rock-wallaby, Greater Bilby, Brush-tailed Mulgara and Great Desert Skink). Accordingly, monitoring at the Project will focus particularly on the threat to these species posed by cats and foxes.

4.3 Assessment Criteria

Monitoring of threatened species populations and management of pest species population density within the Project area will be undertaken at regular intervals as detailed in Table 4-2 to Table 4-5. The monitoring results will be utilised to determine if populations have increased, decreased or remained unchanged, and can be assessed against historical data to indicate trends. Monitoring impacts to groundwater dependent vegetation is detailed in Table 4-6.

Triggers and responses will be determined by predicted 'levels of acceptable change'. Accepted levels of change are determined by known species characteristics and for this program include three scenarios as follows:

- **Population known to fluctuate** - If populations of a species/community are known to fluctuate broadly in size or activity patterns naturally, then a higher level of change (as determined through monitoring) is acceptable during the course of the Project, because that level of change may simply reflect natural fluctuations.
- **Population generally consistent or stable** - If populations of a species/community are known to remain stable or consistent in size or activity patterns, then a lower level of change is acceptable during the course of the Project, because any change at all may indicate that the Project activities is having an impact.
- **Population dynamics unknown** - If the populations or activity levels of a species/community are not understood adequately to determine natural levels of variability, then the smaller the level of change that should be accepted until more can be learned.

With the understanding of species characteristics, levels of acceptable change have been developed for each monitoring and management plan. A summary of acceptable levels of changes and associated definitions are provided in Table 4-1.

Table 4-1 What level of change is acceptable?

Acceptable level of change	When to apply
No increase	When the species/community being considered is known to have very small variation in population size or activity patterns naturally. Thus, detection of any deleterious change (as found through monitoring) suggests that the Project may be having an impact.
Small change	When the species/community being considered is known to have small variation in population size or activity patterns naturally. Thus, detection of small deleterious change (as found through monitoring) suggests that the Project may be having an impact.
Moderate change	When the species/community being considered is known to have moderate variation in population size or activity patterns naturally. Thus, small changes (as found through monitoring) may simply reflect natural variation, but more substantial deleterious change suggests that the Project may be having an impact.
Large change	When the species/community being considered is known to have high variation in population size or activity patterns naturally (e.g. boom-bust or irruptive species). Thus, even moderate changes (as found through monitoring) may simply reflect natural variation, but large and consistent long-term deleterious change suggests that the Project may be having an impact.

4.4 Monitoring and management plans

Monitoring and management plans are required to determine if mitigation measures implemented for the Project are adequately protecting biodiversity. The plans include:

- Non-native and over abundant Native Predator Monitoring Plan – Cat, Fox and overabundant Dingo (Table 4-2)
- Pest Animal Management Plan (baiting and trapping program for predators and vermin) (Table 4-3)
- Monitoring of injured or killed fauna (Fauna Sightings and Fatality Register) Table 4-4
- Threatened species monitoring plan – Sandplain habitats (Greater Bilby, Brush-tailed Mulgara, Great Desert Skink)(Table 4-5)
- Groundwater Dependent Vegetation Monitoring Plan (Table 4-6).

Table 4-2 Non-native and over-abundant Native Predator Monitoring Plan

Program		Pest Monitoring Plan – Cat, Fox and overabundant Dingo
Objective		Establish baseline and subsequent comparative data on local population sizes of feral predators (cat, fox) and dingoes to inform control program.
Survey Effort	Survey	Establish baseline data by undertaking a motion-sensing camera survey prior to construction, using site occupancy as the measure of predator population size and extent.
	Operation	Establish 30 baited camera stations that can be repeatedly used including: • 10 sites within 100 m of proposed mine activities (particularly around the landfill); • 10 sites approximately 1 km from mine activities; and • 10 sites more than 5 km from mine activities. Cameras to be deployed for a minimum of 28 nights.
	Timing	Annual (during operation)
	Personnel	Qualified ecologists.
Trigger Points	Cats / Foxes	Acceptable level of change: No increase Any increase in population size is likely to be detrimental to biodiversity. Action required if >10% increase in numbers of individuals detected across two surveys.
	Dingoes	Acceptable level of change: Moderate change Dingoes are native predators and their presence is likely to limit the population size of other predators (cats and foxes). Therefore, dingo presence and increase in population is acceptable. However, over-abundance of dingoes has the potential to be detrimental to threatened species. Action required if >50% increase in abundance across two surveys.
Contingency		Implement or increase predator control program as required. Increase cat/fox control efforts, through trapping, poisoning, shooting. Make sure predator control method does not result in the unintentional capture or death of threatened fauna species. Record all sightings of predators in the Fauna Sighting and Fatality Register (Appendix A)

Table 4-3 Pest Animal Management Plan

Program		Pest Animal Management Plan (Bait and Trapping Plan)
Objective and approach		Implement a pest eradication/control program targeting foxes, cats and rabbits across the Project area and non-native rats and mice at the Mine Site and Accommodation Village to minimise potential impacts of vermin and pest predators.
Target species		• Non-native rats/mice (e.g. <i>Rattus rattus</i>, <i>Mus musculus</i>) • European Rabbit • Red Fox • Feral Cat; and • Dingo (but only if overabundant).
Rats / Mice	Methods	Poisoned baits in and under buildings and within the confines (fences) of the landfill facility.
	Timing	All year, every year.

	Location	Offices and accommodation areas across the Project area and around the landfill facility.
Rabbits	Methods	Warren fumigation and/or ripping. Prior to control methods being used on a suspected rabbit warren, motion-sensing cameras must be deployed at warren entrances for at least 30 days during the warmer months (October to March) to make certain that the burrows aren't used by any threatened fauna species. If any burrow is found to support a native threatened species, then fumigation and warren ripping are not suitable. Other rabbit-control methods are to be established (e.g. trapping, shooting).
	Timing	All year, as required. The need for rabbit control will be informed by the Fauna Sighting and Fatality Register (Appendix A), and the results of other fauna monitoring (e.g. use of motion-sensing cameras).
	Location	Across Project area, particularly in sandplain areas where the impact of rabbits on native threatened species has the potential to be greater.
Cats / Foxes	Methods	A range of methods is to be trialled upon the outset of the Project to determine the most effective and efficient method. Possible methods include: • Poisoned baiting; • Trapping (e.g. cage trapping); • Shooting; and • Grooming traps (innovative new passive baiting and trapping methods that target cats (http://www.ecologicalhorizons.com/initiatives). Grooming Traps may provide a long-term tool to control trap-shy or bait-shy cats in areas of high conservation value (e.g. in areas of known Greater Bilby habitat) or in the vicinity of accommodation areas and waste containment facilities.
	Timing	Annually, and more frequently if required on the basis of monitoring results.
	Location	Mine Site and broader Project area. Focus efforts initially in and around the mine site and landfill facility where non-native rats and mice are most expected to attract non-native predators. Expand area of control if any of the fauna monitoring or Fauna Sighting and Fatality Register (Appendix A) data suggest that predator numbers have increased in areas away from the Mine Site. Feral cat control should also occur in areas where threatened species are known.
Dingoes	Methods	Dingoes are native predators and are not expected to require regular or frequent active population control measures as they are known to suppress introduced predator abundance (cats, foxes) in turn resulting in increased small mammal/reptile abundance and diversity. However, if the mine activities promote an increase in non-native rats and mice and allow access to food waste, allowing dingo populations to get unnaturally large to the point where they threaten native fauna also, then control measures may be required. Possible methods include: • Poisoned baiting; or • Shooting. Control of dingo populations, if required, is expected to involve removal of relatively small numbers of individuals, rather than broadscale population control (as this may be detrimental to small mammals/reptiles) and would be undertaken in consultation with regulatory authorities.
	Timing	As needed, on the basis of monitoring results.
	Location	Across mine site and broader Project area, as required.
Contingency		Implement or increase predator and pest-animal control program as required. Make sure predator and pest-animal control method does not result in the unintentional capture or death of threatened fauna species. Record all sightings of predators and vermin in the Fauna Sighting and Fatality Register (Appendix A)

Table 4-4 Monitoring of injured and killed fauna and non-native predators (using the Fauna Sighting and Fatality Register, Appendix A)

Program	Fauna Monitoring – Register
Objectives	• Inform population dynamics of feral predators and pest animals, in conjunction with monitoring programs. • Document numbers of fauna (including threatened species) injured or killed as a result of Project activities • Document sightings of threatened species in the Project area.

Method	Survey	The following records will be kept in the Fauna Sighting and Fatality Register (Appendix A): - Predator and pest-animal sightings - Injured or killed fauna - Threatened species sightings. Input will be opportunistic, however all personnel will be encouraged to report all sightings of cats (including colour and identifying markings, if possible), foxes, rabbits and dingoes, threatened fauna, injured or killed animals.
	Timing	Continually.
	Personnel	All personnel.
Contingency		Implement or increase predator and pest-animal control program as required (e.g. if there is a notable increase in sightings of non-native predators in the study area). Increase cat/fox/rabbit control efforts, through trapping, poisoning, shooting, in consultation with DLRM and CLC. Make sure predator/pest control method does not result in the unintentional capture or death of threatened fauna species. On an annual basis, map the records of fauna killed or injured during Project activities. If hotspots occur, then increase or add new mitigation efforts at those locations to reduce the incidence of the particular impact. On an annual basis, map the records of threatened fauna sighted during Project activities. If hotspots occur, then increase or add new mitigation efforts for those species at those locations to minimise the likelihood of impact.

Table 4-5 Threatened Species Monitoring Plan – Sandplain Habitats (Greater Bilby, Brush-tailed Mulgara, Great Desert Skink)

Program		Threatened species monitoring – Sandplain Habitats
Objective		- To document the persistence of known threatened species in the vicinity of the mine, and to evaluate the effectiveness of predator control measures; and - To detect population increases in low-abundance threatened fauna (e.g. Greater Bilby, Great Desert Skink) across the Project area.
Method	Survey	Motion-sensing camera surveys within known threatened species habitat for Greater Bilby, Brush-tailed Mulgara and Great Desert Skink, targeting areas that contain known burrows/warrens. Transect surveys searching for new warrens within known threatened species habitat for Greater Bilby, Brush-tailed Mulgara and Great Desert Skink. Camera surveys will comprise at least five 400 m camera transects, each comprising 5 cameras at 100 m intervals and be left <i>in situ</i> for 28 nights during Great Desert Skink active season.
	Locations	Sandplain Habitat.
	Timing	Every two years, then annual, if threatened species populations found.
	Personnel	Qualified ecologists.
Trigger Points		Acceptable level of change: moderate change Additional mitigation action required if populations detected, and then: >20% decrease in numbers of Greater Bilby, Brush-tailed Mulgara, Great Desert Skink and in the preceding year an incident of roadkill is recorded; - Predator monitoring shows that numbers of predators in the study area over the preceding 12 months increased (cat and fox) or increased greatly (dingo); or - Wildfire in the sandplain habitat during the preceding 12 months and Greater Bilby, Brush-tailed Mulgara, Great Desert Skink not detected.
Contingency		Mitigation measures include: - Increase cat/fox control efforts (trapping, poisoning, shooting) if predator numbers have increased; - Broaden fire breaks in high risk areas to prevent future fires, if fire may have been responsible, and - Reduce vehicle speeds or access in high-risk areas if roadkill may have been the cause.

Table 4-6 Groundwater Dependent Ecosystem Monitoring Plan

Program		Groundwater Dependent Ecosystem Monitoring Plan
Objective		Document the health and response of GDEs to groundwater extraction activities.
Method	Survey	The monitoring program should include:

		- Monitoring sites at varying distances from the centre of groundwater drawdown zone, as well as upstream and downstream of the zone. At each site, permanent transects to be established with all phreatophytic trees numbered and tagged. A minimum of 20 trees to be tagged per transect. - Permanent quadrats also to be established at each monitoring site to monitor understorey species (part of overall GDE health). - Transect monitoring parameters (for each phreatophytic tree): ID, height, diameter at breast height (DBH), % cover alive canopy foliage, health score/ranking and photograph. - Other optional transect monitoring parameters (for each phreatophytic tree): may include isotopic analysis to quantitatively measure tree stress, and heat pulse test to measure tree water use. - Quadrat monitoring parameters: list of all species, height, number and % cover of live plants, number and % cover of dead plants and photographs.
	Locations	GDEs within the predicted groundwater drawdown zone for the borefield (along the Hanson River) and mine pit (along Murray Creek). Target vegetation includes the riparian woodland along watercourses and drainage channels (VT3) and low <i>Corymbia</i> woodland on loamy alluvial plains (VT4).
	Timing	Annual (including prior and during operation)
	Personnel	Qualified ecologists
Trigger Points		To be determined based on detailed review of published literature and site-specific baseline data collected prior to groundwater extraction activities.
Contingency		No contingency measures are proposed.

5. Previous Period Performance

No data from the previous period is available for review.

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Appendices

Appendix A – Fauna Sighting and Fatality Register

Table A1 Fauna Sighting and Fatality Register

Date (--/--/--)	Time (--:--)	Animal (Type / Name)	Number/count	Condition (Sighting, Injured, Dead)	Conservation Status (Native, Migratory, Feral, Introduced, Threatened, Unknown)	Location (Reference to infrastructure or Haul Road chainage)	Interaction Details (Summary of interaction including how fauna was injured or killed, what Project activities were being undertaken, and what measures were in place)

Appendix B – Threatened Flora Species

THREATENED SPECIES OF THE NORTHERN TERRITORY

DWARF DESERT SPIKE-RUSH

Eleocharis papillosa



Conservation status

Australia: Vulnerable.

Northern Territory: Vulnerable.

Conservation reserves where reported:

None.

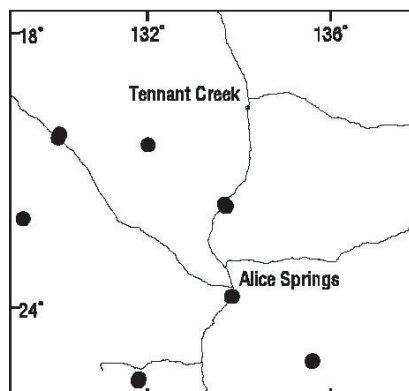
Description

The dwarf desert spike-rush is a small erect perennial sedge, typically less than 10 cm high. The above ground parts grow in response to inundation, subsequently dying back to underground parts which consist of roots, rhizomes and tuberoids. The leaf sheaths are purplish at base.

Flowering and fruiting: recorded throughout the year.



Eleocharis papillosa.



Known locations of *E. papillosa*.

Ecology

All records are from temporary wetlands; predominantly freshwater and semi-saline swamps but one record is from the edge of a temporary riverine waterhole.

Growth, seeding and germination are presumed to occur in response to temporary inundation. Seed set has not been observed at Ilparpa Swamp which is the most frequently visited location.

Cultivated greenhouse plants from Ilparpa, with constant water conditions, have also 'failed' to set seed. However, some herbarium specimens from other locations do have seed, indicating that sexual reproduction may occur in some populations. The abundance of above ground shoots may vary between different inundation events. On occasions it can be difficult to determine whether a population consists of many

Distribution

The dwarf desert spike-rush is endemic to the NT. It is known from just eight locations, ranging from the northern Tanami Desert to the southern parts of the Finke bioregion and the edge of the Simpson Desert (White *et al.* 2000). Most locations are remote and repeated collections have been made at only three of them. The latitudinal range of the species is 600 km and the longitudinal range is 560 km.



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individuals or few individuals that are extensively rhizomatous. The species has been locally abundant (estimated at up to approximately 1000 plants, D.Albrecht and P.Latz *pers. obs.*) at some times at some sites. However, the actual number of genetically different individuals may be substantially fewer in some populations where asexual reproduction is significant.

During dry times, populations persist as soil-stored seed or soil-stored root tuberoids and/or rhizomes. Plants with constant water conditions (at the Alice Springs Desert Park Nursery) exhibit an annual die-off of the above ground shoots. It is not known what controls this but age, season and cold are all possible factors. These plants subsequently resprout. Informal trials indicate that resprouting can occur from the tuberoids after they have been stored in dry conditions (Tim Collins *pers. comm.*).

The dominant plants at some sites are *Eucalyptus coolabah* (Coolibah), *Halosarcia sp.* (Samphire), *Chenopodium auricomum* (Northern Bluebush) and *Eragrostis spp.* including *E. australasica* (swamp canegrass). It is recorded as growing both in the open and under shrubs, which may provide protection from trampling by stock at some sites.



A semi-saline swamp with

E. papillosa

Conservation assessment

Eleocharis papillosa appears to be genuinely rare. Due to its small size and the intermittent presence of surface shoots it is likely that it is 'under collected' and that additional populations do exist. However, an extensive survey of wetlands in 2000 and 2001, in apparently ideal conditions, only found one new population (Duguid *et al.* 2002). The population at Ilparpa Swamp and one from the Burt Plain bioregion are being encroached upon by the exotic couch grass (*Cynodon dactylon*) such that they are highly likely to be eliminated. Recent searches (in 2000, 2001, 2002, 2003 and 2004) at Ilparpa Swamp, following two particularly wet summers, failed to find the species.

It is rated as **Vulnerable** (under criteria: B2ab(iii,iv)) due to:

- the small area of occupancy (<2000 km²);
- the severely fragmented distribution;
- the small number of known locations (<10); and
- a continuing/projected decline in the area, extent and quality of habitat and number of subpopulations.

Threatening processes

Invasion by couch grass (*Cynodon dactylon*) is the main threat at two populations. Changed hydrological conditions may affect some subpopulations. Trampling by stock occurs at some sites, but any long-term effect is unquantified.

Conservation objectives and management

Known populations require monitoring as does the spread of couch grass. The feasibility of controlling couch grass in swamp environments needs to be investigated.



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Threatened Species Information Sheet

Compiled by

Angus Duguid
Raelee Kerrigan
David Albrecht
[June 2006]

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Appendix C – Factsheets for threatened fauna identified at Mount Peake.

Threatened Species of the Northern Territory

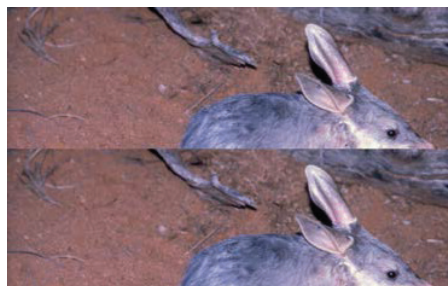
GREATER BILBY BILBY

Macrotis lagotis

Conservation status

Australia: Vulnerable

Northern Territory: Vulnerable



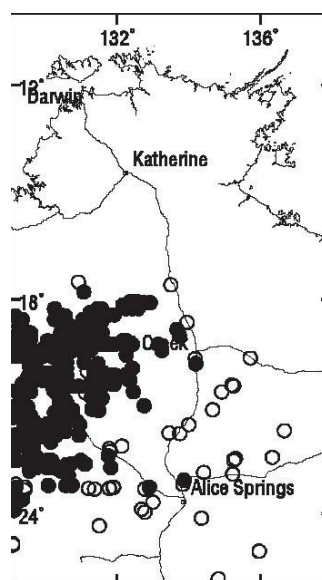
Description

The greater bilby is a large bandicoot (body mass males, 800-2500g; females, 600-1100g) with soft silky fur. The fur is ash grey over most of the body, whereas on the belly it is pure white to cream. The basal 20 percent of the tail is the same colour as the upper-body, the central 40 percent is black and the distal 40 percent, pure white. The forelimbs are robust and equipped with three stoutly clawed toes (and two unclawed toes) giving the animal a formidable burrowing capacity. The slender hind limbs are long and resemble those of macropods. The snout is long and delicate and the ears are large and rabbit-like.

Distribution

Within the Northern Territory, it occurs in the central and western parts of the Tanami bioregion, the southern Sturt Plateau bioregion and the northern Great Sandy Desert bioregion. The distribution is highly fragmented within this area. The most southerly recent records are in the vicinity of Kintore, the most northerly around Newcastle Waters and Wave Hill.

Historically, the greater bilby occupied a vast area of arid and semi-arid Australia. Its distribution declined dramatically in the years following European settlement and it now occupies about 20% of its former range. The species occurs in two separate geographic areas; one extending from the western deserts region of the Northern Territory and Western Australia north to the Pilbara and Kimberley regions, the second in the Channel Country of south-west Queensland (Watts 1969; Southgate 1990a).



Known locations of the greater bilby.
o = pre 1970; • = post 1970.

Conservation reserves where reported:
None (although it formerly occurred in areas that are now included within Uluru Kata-Tjuta National Park, Watarrka National Park and West MacDonnell National Park).

Ecology

Habitat of the greater bilby in the Northern Territory is characterised by sandy soils dominated by hummock grasslands covered predominantly by three species of spinifex, *Triodia basedowii*, *T. pungens* and *T. schinzii*. An overstorey of low shrub cover dominated by *Acacia* and *Melaleuca* species grows over much of this country. This predominantly sandy landscape also includes rocky outcrops, laterite rises and low lying drainage systems (Southgate 1990b). Broad-scale surveys of bilbies in the Northern Territory in the 1990s indicated that laterite and drainage line land systems were occupied more frequently than sand plain and dune systems.

The greater bilby is omnivorous and major foods vary across seasons (Southgate 1990b). Important plant foods include seed from various grasses and sedges including Button Grass (*Dactyloctenium radulans*), Desert Flinders Grass (*Yakirra australiensis*) and Parakeelya (*Calandrinia* spp.) and bulbs from Bush Onion or Yalka (*Cyperus bulbosus*) and *Wurmbea deserticola*, many of which are most abundant soon after fires (Southgate and Carthew 2006). At a site in central Australia, fruiting bodies of underground fungi were the major dietary component. Major invertebrate prey includes termites, ants, beetles, insect larvae and spiders. Most of the food of the Greater Bilby is excavated from the soil and holes may attain 25 cm in depth.

Bilbies dig burrows up to two metres deep and an individual may have over a dozen regularly used burrows within its home-range. Bilbies forage at night. Movements of 5 km during one night have been recorded for male

bilbies. Males, females and juveniles may occupy overlapping home ranges. Densities of 12–16 individuals/km² are reached in optimal habitat. However; a density of 1–2/km² is more typical (Southgate 1987).

Litters, comprising one to three young, can be produced at any time of year (Southgate *et al.* 2000). Young remain in the pouch for approximately 75 days, before being cached and suckled in maternal burrows for a further two weeks prior to independence. Under ideal conditions, there is the potential to produce four litters every year. Captive animals live up to 10 years (Southgate *et al.* 2000).

Conservation assessment

No estimates are available for the size of the Northern Territory population of the greater bilby. The range of the species in the Territory is declining and contracting northwards. For example, populations located in the vicinity of Alice Springs in the late 1960s (Watts 1969) are no longer present. However, bilbies in the Northern Territory appear to be nomadic and undergo large population fluctuations in response to food availability. These characteristics result in it being difficult to accurately assess population trends for two reasons. First, no sites are known in the Territory that are considered to permanently hold colonies of bilbies. Second, depending on rainfall and food availability, very few bilby records may be reported during one time period but this can change quickly. This natural variation must be taken into account when considering the conservation status of the species.

Notwithstanding the above caveats, the greater bilby is **Vulnerable** in the Northern Territory (under criteria C2a(i)) based on:

- population size estimated to be <10,000 mature individuals;

- continuing decline in numbers of mature individuals; and
- no subpopulation estimated to contain more than 1000 mature individuals.

Threatening processes

Predation by the introduced European fox appears to be the major threat faced by the greater bilby in the Northern Territory (Southgate 1987). Predation by other carnivores (i.e. feral cat, dingo) could also threaten bilby populations. However, there is considerable interaction between these three predators. Specifically, dingoes may protect a range of native species, including bilbies, by controlling cats and foxes either through direct predation or excluding them from carrion during droughts.

Competition with rabbits may also be an important threatening process faced by the greater bilby. However, the negative impact of rabbits has been greatly reduced following the release of rabbit calicivirus disease (RCD) in the 1990s. Grazing by cattle may be a threat on some pastoral leases. Unsuitable fire regimes may restrict breeding and impede dispersal into unoccupied areas, and reduce food options and availability (Southgate and Carthew 2006).

Conservation objectives and management

A national Recovery Plan for the greater bilby was established in 2006 (Pavey 2006).

The plan recommends the following management actions that include the Northern Territory:

- reduce fox and cat numbers at key wild populations where bilbies are in decline;
- continue husbandry and coordinated management of captive populations;

- refine monitoring methodology;
- monitor trends in occurrence at wild populations; and
- continue to manage the recovery process through a national recovery team.

The greater bilby is maintained in captivity at the Alice Springs Desert Park and is displayed in its nocturnal house. National Bilby Day takes place in September each year and the Desert Park is a focus for educational activities involving the species.

Compiled by

Chris Pavey
[May 2006]

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Threatened Species of the Northern Territory

BLACK-FOOTED ROCK WALLABY

Petogale lateralis

Conservation status

Australia: Vulnerable

Northern Territory: Near Threatened



Description

The black-footed rock-wallaby is a moderately-sized macropod with a body mass of 2.8-4.5 kg. As in other rock-wallabies, the tail (mean length of 56 cm) is longer than the head-body (mean length of 49 cm).

Northern Territory animals belong to a currently undescribed subspecies, centred in the MacDonnell Ranges. A dense coat of dark grizzled brown fur passing to grey on the shoulders distinguishes this subspecies. The chest is grey; the belly buff. The face is marked by a sandy cheek stripe. The ears are dark brown near the tip fading to fawn at the base. A dark brown to black dorsal stripe extends from between the ears to behind the shoulders. The feet are grey brown and the digits are black. The forearms are sandy dorsally and darker ventrally and the paws are dark brown to black. A distinct white stripe with wider dark brown stripe immediately ventral extends from the axillary patch to the thighs. The tail is dark grey proximally, becomes browner distally and ends in a dark brown to black brush.

Distribution

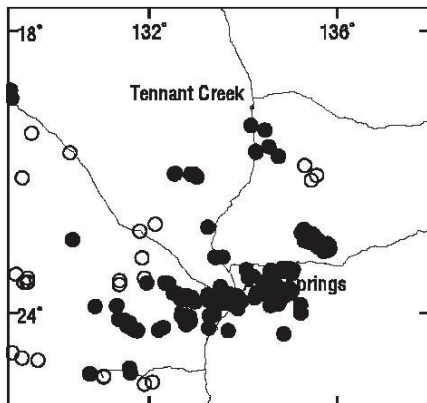
The distribution of the MacDonnell Ranges subspecies is centred on the MacDonnell Ranges bioregion of the southern Northern Territory. In the Territory, its range extends north to the Davenport and Murchinson Ranges, east to the Jervois Range, west to the Western Australian border and south to the South Australian border. Outside the Territory, it occurs in the Gibson Desert of Western Australia (Eldridge *et al.* 1992; Pearson 1992) and in the Anangu-Pitjatjantjara lands of northern South Australia.

In southern parts of its range this wallaby has declined in density and distribution or become locally extinct. However, with the exception of recent extinctions at the Granites (Tanami Desert) and at Uluru - Kata Tjuta National Park, the population size and distribution of the black-footed rock wallaby has remained stable in the Northern Territory.

Other subspecies of black-footed rock-wallabies occur in Western Australia, and islands off the coast of South Australia (Eldridge and Close 1995).

Conservation reserves where reported:

Alice Springs Telegraph Station Historical Reserve, Arltunga Historical Reserve, Davenport Range National Park, Emily and Jessie Gap Nature Park, Finke Gorge National Park, Kuyunba Conservation Reserve, Ruby Gap Nature Park, Trepkina Gorge Nature Park, Watarrka National Park, West MacDonnell National Park.



Known locations of the black-footed rock-wallaby.
o = pre 1970; • = post 1970.

Ecology

Black-footed rock-wallabies occur in rocky outcrops and associated steep rocky slopes. They feed on grass, but some herbs and some leaves and fruits are also eaten (Eldridge and Close 1995). Though occasionally drinking when water is present they can survive without water. Water requirements are reduced by sheltering during the day in caves and under boulders where relative humidity is higher and air temperatures cooler. They usually emerge in the late afternoon or early evening to feed. After a cold night animals may bask in the sun during the early morning.

Breeding is potentially continuous but may be influenced by seasonal factors. Embryonic diapause is a feature of reproduction.

Conservation assessment

A recent comprehensive assessment by Gibson (2000) provided strong evidence that this species retains much the same distribution in the Northern Territory as it had at the time of European settlement and that numbers in conservation reserves have remained stable or increased over the past 20 years. The extent of occurrence within the Territory is estimated at 37 000 km² (Gibson 2000).

Although populations in the extreme south of its range have declined or become locally extinct over the past 20-30 years, the species has disappeared from only 21 of 400 sites surveyed (5%) in the Territory. Further, most of these sites were small, isolated hills that supported small populations. Based on this information the black-footed rock-wallaby qualifies as **Near Threatened** in the Northern Territory.

Threatening processes

Major threats faced by isolated populations in Western Australia and South Australia and parts of the Northern Territory include predation by introduced (European fox, feral cat) and native (wedge-tailed eagle) predators, and habitat degradation caused by grazing by introduced herbivores. The decline of local populations in southern regions correlates with time of arrival of foxes after establishment of rabbits. Circumstantial evidence from work on another subspecies of the black-footed rock-wallaby in the Western Australian Wheatbelt and Rothschild's rock-wallaby in the Dampier Archipelago strongly supports the contention that foxes have played a major role in the decline of the species.

Conservation objectives and management

There is no existing management program for the species in the Northern Territory. A national Recovery Plan for five species of rock-wallaby, currently being prepared by the Western Australia Department of Conservation and Land Management (CALM), will include the MacDonnell Ranges subspecies of the black-footed rock-wallaby.

Management priorities in the Northern Territory are to:

- i. continue to monitor key populations of the species both on and off park; and
- ii. protect key populations by carrying out fox and feral cat control where populations appear threatened by predation.

Complied by

Chris Pavey
[May 2006]

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Threatened Species of the Northern Territory

BRUSH-TAILED MULGARA (MULGARA)

Dasyurus blythi

Conservation status

Australia: Vulnerable (as *D. cristicauda*)

Northern Territory: Vulnerable



Description

The brush-tailed mulgara is one of the larger carnivorous marsupials with a body mass of over 100 g, head body length of 15 cm and tail length of 9 cm. The species shows sexual dimorphism in size; males are significantly larger than females (Masters *et al.* 2003). The back is sandy brown and the belly is greyish-white. The short tail is enlarged and reddish near the body, tapering quickly to a point.

There has been considerable taxonomic confusion and re-sorting of the mulgaras. For most of the last 30 years only one species, *D. cristicauda*, was recognized. More recently, based on some genetic and morphological attributes, two species were recognized, the Mulgara *D. cristicauda* and Ampurta *D. hillieri* (Adams *et al.* 2000), with both occurring in the Northern Territory. However, Woolley (2005, 2006) re-considered the complex historical treatment of *Dasyurus* and re-assigned the species to the brush-tailed mulgara *D. blythi* and crest-tailed mulgara *D. cristicauda*, both of which occur in the Northern Territory. Woolley (2005, 2006) distinguished these two species on the following characteristics: (i) appearance of black hairs on the distal half of the tail (a brush in *D. blythi* versus a dorsal

crest in *D. cristicauda*), (ii) the number of upper pre-molar teeth (two in *D. blythi* versus three in *D. cristicauda*), and (iii) in females, the number of teats (6 in *D. blythi* versus 8 in *D. cristicauda*).

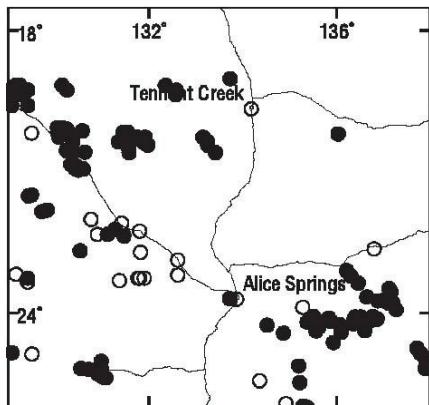
Distribution

Because most previous records did not distinguish among the two species of mulgara now recognized, there is ambiguity about the distribution of both species.

The brush-tailed mulgara is known from at least the western and Simpson deserts, with confirmed records in the Northern Territory from Haast Bluff, Uluru, Papunya, Tanami Desert, Illamurta, Charlotte Waters and Crown Point (Woolley 2005, 2006).

The species was once widespread and common throughout the central deserts region of Australia. However, it began to decline in the 1930s and now has a more restricted and fragmented distribution than in the past.

Conservation reserves where reported:
Uluru-Kata Tjuta National Park.



Known locations of mulgara (note that this map includes records that may be either *D. blythi* or *D. cristicauda*).

o = pre 1970; • = post 1970.

Ecology

Brush-tailed mulgaras are primarily nocturnal, and shelter during the day in burrows that are about 0.5 m deep. Some animals are known to “sunbake” during the day in cold weather. The species is both insectivorous and carnivorous taking a range of insects, scorpions, centipedes, rodents, small marsupials and reptiles.

Brush-tailed mulgaras occur in a range of vegetation types; however, the principal habitat is mature hummock grasslands of spinifex, especially *Triodia basedowii* and *T. pungens* (Masters *et al.* 2003). The location of brush-tailed mulgara colonies may be influenced by the presence of better watered areas such as paleo-drainage systems or drainage lines in sandplain or sand dune habitats.

The species breeds once per year, mating in autumn or winter with litters of 3-6 young being produced between October and December. Home range size is highly variable with extremes of 1.0 to 14.4 hectares recorded (Masters 2003). Home ranges of individuals overlap extensively.

Conservation assessment

Numbers fluctuate dramatically according to climatic conditions making it difficult to estimate the size of the population and, as a consequence, to determine population trends.

Assessment of the conservation status of this species is further complicated by the historical (and in some cases, current) ambiguity of records attributable to this species as distinct from those of *D. cristicauda*.

The decline in the range of the brush-tailed mulgara in the Northern Territory occurred earlier than relevant to IUCN criteria (i.e. <10 years or three generations). However, the species qualifies as Vulnerable (under criteria C2a(i)) based on:

- a population estimated to be
- <10,000 mature individuals;
- a continuing decline observed, projected, or inferred and
- no subpopulation estimated to contain >1000 mature individuals.

Threatening processes

The cause of decline in the brush-tailed mulgara is unknown and, therefore, it has not been possible to identify threatening processes. However, it is likely that the processes of environmental degradation and habitat homogenization that have occurred throughout arid Australia following European settlement have negatively affected the mulgara. Changes in fire regimes, grazing by introduced herbivores including cattle and rabbits, and predation by introduced predators are all likely threatening processes.

Conservation objectives and management

A national Recovery Plan for mulgaras is due for release in 2007.

Management priorities in the Northern Territory are:

- i. to better safeguard existing populations by ensuring that large areas of mature spinifex are not subjected to extensive wildfires;
- ii. to continue regular monitoring of the relatively large population(s) in Uluru-Kata Tjuta NP/Yulara bore fields (currently being undertaken by Parks Australia and Voyages Hotels and Resorts, respectively);
- iii. to better resolve the status and distribution of the two mulgara species; and
- iv. to prevent harmful disturbances (e.g. mining operations) within lateritic areas in the north of the range.

This species is held and bred at the Alice Springs Desert Park.

Compiled by

Chris Pavey

Jeff Cole

John Woinarski

[December 2006]

References

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Threatened Species of the Northern Territory

COMMON BRUSHTAILED POSSUM (Central Australian population)

Trichosurus vulpecula vulpecula

Conservation status

Australia: Not listed

Northern Territory: Endangered



Description

The common brushtail possum is a medium-sized mammal (body mass of 1.3-3 kg) about the size of a domestic cat. It has large, prominent ears that have a narrowly round tip and are longer than they are broad. The bushy tail is slightly shorter than the head-body length.

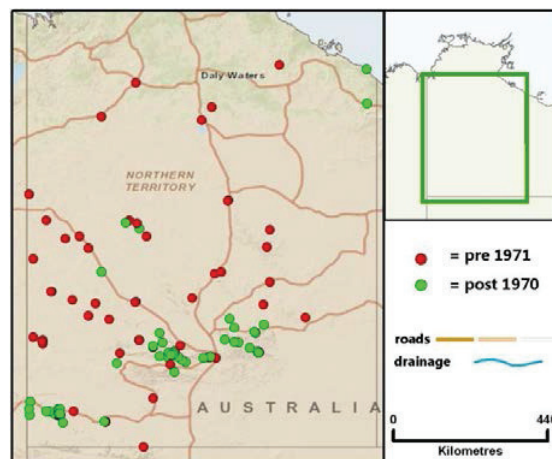
Distribution

Two subspecies of common brushtail possum occur in the Northern Territory (NT). The subspecies *T. v. vulpecula*, occurs in isolated populations in the southern NT. It formerly had a much more extensive distribution in the NT that included most of the Tanami and Great Sandy Deserts across to the Western Australian border at Lake Mackay and Kintore, south to Charlotte Waters, east to the Todd and Hale River floodouts in the Simpson Desert, and as far north as the Murchinson Ranges. Outside the NT, this subspecies occurred across much of the continent, including South Australia, Victoria, New South Wales, southern and south-western Queensland and much of Western Australia. It remains common in much of this area, including urban areas of most capital cities.

The subspecies *T. v. arnhemensis* occurs in the monsoon tropics of the Top End of the NT and in the Kimberley, Western Australia. It remains locally common (notably in some Darwin suburbs), but is generally declining (Woinarski 2004) and is listed as Near Threatened in the NT.

Other subspecies of the common brushtail possum occur in Tasmania, and north-eastern Queensland; and introduced populations abound in New Zealand.

Conservation reserves where reported: West MacDonnell National Park, Ruby Gap Nature Park and Uluru-Kata Tjuta National Park.



Known locations of the Central Australian common brushtail possum

Ecology

In Central Australia, the common brushtail possum now occupies riverine habitat that is close to rocky outcrops and moist gullies within the ranges or rocky slopes (Kerle *et al.* 1992). This habitat occurs on various geological substrates but is characterized by a diverse association of fire-sensitive plant species. Its former habitat in Central Australia included river systems supporting large eucalypts, coolibah claypans and spinifex grasslands with a shrubby overstorey (Burbidge *et al.* 1988).

A range of sites is used as shelter including caves and rock holes, tree hollows and the tops of dense trees. The diet consists of the flowers, fruits and leaves of a wide range of non-eucalypt species (Evans 1986).

Conservation assessment

In Central Australia, the brushtail possum was widespread and common prior to and during the first few decades of European settlement. However, it subsequently underwent a dramatic decline in both numbers and range between the 1920s and 1950s (Finlayson 1961; Burbidge *et al.* 1988). Although the most extreme phase of the decline had occurred by the early 1940s, local extinctions continued until the last decade, with possums disappearing from Uluru-Kata Tjuta National Park, and Alcoota and The Gardens Stations during the 1980s (Kerle *et al.* 1992). Although West MacDonnell National Park is a stronghold for the species, there is no information available on actual population size. The bulk of the population may occur at rarely visited sites in the ranges with records of scats and sign at sites such as Ormiston Creek and Roma Gorge being produced by animals possibly dispersing from these core areas.

The decline in the common brushtail possum in Central Australia occurred earlier than relevant to IUCN criteria (i.e. within the last ten years or three generations). However, the subspecies *T.v. vulpecula* still qualifies as **Endangered** in the NT (under criteria B1ab(i)+2ab(ii)) based on:

- extent of occurrence <5 000 km²;
- area of occupancy <500 km²;
- severely fragmented; and
- a continuing decline in extent of occurrence.

Threatening processes

The decline of the common brushtail possum in Central Australia has been attributed to the interaction between severe drought and a suite of potential threatening processes. These factors include habitat homogenization as a result of grazing by introduced herbivores (cattle and rabbits), increased hunting around Aboriginal settlements and (historically) for the commercial fur trade, altered fire regimes, and predation (Kerle *et al.* 1992; Woinarski 2004). One or more of these threatening processes is proposed to have severely reduced possum populations that had retracted to high quality refuge areas during the droughts of the 1920s and 1950s, leading to local extinctions.

Conservation objectives and management

There is no existing management program for wild populations of this species in the NT.

Research priorities for the Central Australian subspecies are to:

- i. determine the extent of the distribution of the population in the West MacDonnell National Park; and

- ii. investigate recent signs of the species in other areas, particularly on Indigenous lands.

Management priorities for the Central Australian subspecies are to:

- i. monitor the occurrence of the species in core areas of the West MacDonnell National Park;
- ii. undertake predator control measures if predation is shown to affect populations within conservation reserves; and
- iii. assess the possibility of establishing a captive breeding population, and translocation options (e.g. Foulkes and Kerle 1990).

Complied by

Chris Pavey

Simon Ward

[updated December 2012]

References

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Threatened Species of the Northern Territory

GREAT DESERT SKINK TJAKURA

Egernia kintorei

Conservation status

Australia: Vulnerable

Northern Territory: Vulnerable



Photo: Steve McAlpin

Description

The great desert skink is a large, smooth bodied lizard with an average snout-vent length of 200 mm (maximum of 440 mm) and a body mass of up to 350 g. Males are heavier and have broader heads than females. The tail is slightly longer than the snout-vent length. The upperbody varies in colour between individuals and can be bright orange-brown or dull brown or light grey. The underbody colour ranges from bright lemon-yellow to cream or grey. Adult males often have blue-grey flanks, whereas those of females and juveniles are either plain brown or vertically barred with orange and cream.

Distribution

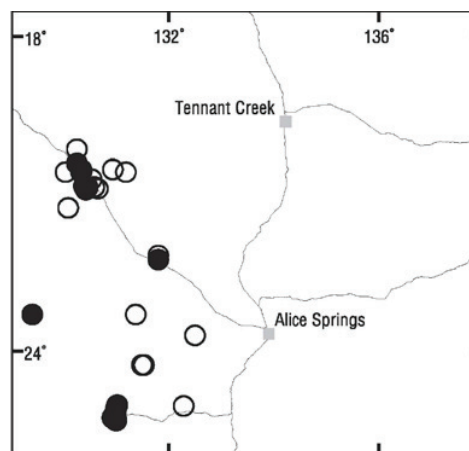
The great desert skink is endemic to the Australian arid zone. In the Northern Territory, most recent records (post 1980) come from the western deserts region from Uluru- Kata Tjuta National Park north to Rabbit Flat in the Tanami Desert. The Tanami Desert and Uluru populations are both global strongholds for the species.

Outside the Northern Territory it occurs in north-west South Australia and in the Gibson Desert and southern sections of the Great

Sandy Desert of Western Australia. Its former range included the Great Victoria Desert, as far west as Wiluna, and the northern Great Sandy Desert.

Conservation reserves where reported:

Uluru-Kata Tjuta National Park, Watarrka National Park, Newhaven Reserve (a large pastoral lease in the Great Sandy Desert managed for conservation by Birds Australia and the Australian Wildlife Conservancy).



Known locations of great desert skink.
o = pre 1970; ● = post 1970.

Ecology

The great desert skink occupies a range of vegetation types with the major habitat being sandplain and adjacent swales that support hummock grassland and scattered shrubs. In the Tanami Desert, it also occupies paleodrainage lines on lateritic soils supporting *Melaleuca* shrubs. It is an omnivore that feeds on a wide variety of invertebrates (particularly termites), small vertebrates, and the leaves, flowers and fruits of plants.

The great desert skink is a livebearer that gives birth to 1-5 young between December and February.

It is a communal species that digs complex burrow systems to a depth of >1 m and with a diameter (of the entire burrow system) of up to 10 m. Up to 10 individuals may share a large burrow system which can have 5-10 entrances. Latrines, where animals defaecate over an area of 1-3 m, are located at the surface of occupied burrows.

Conservation assessment

The maximum size of each population of great desert skink in the Northern Territory has been estimated as 2250 in the Tanami Desert, 500 in Uluru- Kata Tjuta National Park and 350 in land surrounding Yulara (McAlpin 2001). This total represents about 50% of the global population of the species.

Although the species no longer occurs in eastern parts of its former range in the Northern Territory, there is a lack of information on population trends at any sites. However, it can be reasonably inferred that there is a high likelihood that remaining populations will be subjected in the near future to the same threats that have extirpated populations elsewhere. Given this premise, the species qualifies as **Vulnerable** (under criteria C2a(ii)) due to:

- population <10,000 mature individuals;
- continuing decline, observed, projected or inferred, in numbers; and
- no population estimated to contain more than 1000 mature individuals,

Threatening processes

No single factor has been demonstrated to have caused the decline of the great desert skink; however, several potential threatening processes have been identified.

Habitat homogenization as a consequence of the cessation of traditional land management practices may be a serious threat throughout much of its range. Large scale, intense wildfires that result from a lack of patch burning can devastate or fragment local populations. Predation by feral cats and the European fox may also be a serious threat, as could predation by native predators such as the dingo or raptors (particularly in recently burnt areas). Rabbits also have the potential to dig up burrow systems.

Conservation objectives and management

A national Recovery Plan for the species was adopted in 2001.

Management priorities for the species in the Northern Territory, as set out in the Recovery Plan, are:

- i. to assess causal factors in the recent decline or local extinction of the species in particular locations, and to determine critical habitat;
- ii. to manage by 2010 the population in Uluru-Kata Tjuta National Park to maintain or improve population levels (as measured by number of active burrows) against an initial baseline

- figure derived from five seasons of monitoring;
- iii. to improve community knowledge of the species and to improve community involvement in its recovery management;
 - iv. to determine the best fire regime that leads to sustained or increased populations of great desert skink;
 - v. to reduce number, extent and impact of severe wildfires over the next decade;
 - vi. to implement feral predator control programs that result in sustained reductions in feral predator populations in Uluru-Kata Tjuta National Park over the next 10 years.

Complied by

Chris Pavey
[May 2006]

References

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Threatened Species of the Northern Territory

GREY FALCON

Falco hypoleucos

Conservation status

Australia: Not listed

Northern Territory: Vulnerable



Photo: P. McDonald

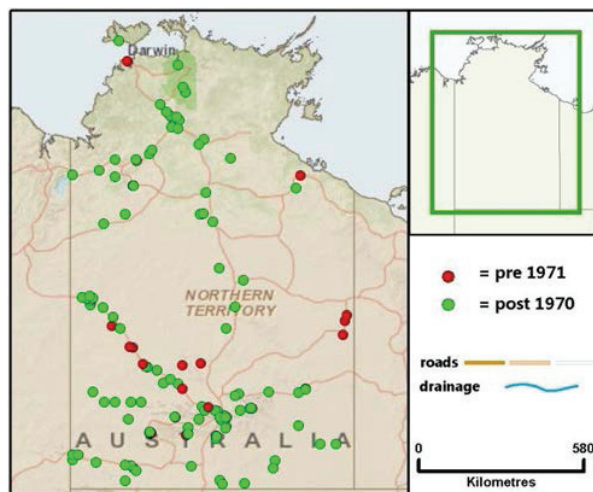
Description

The Grey Falcon is a medium-sized compact pale falcon. The head and upperparts are a light blue-grey, with darker grey flecking on the wings and barring on the tail. The wing-tips are black. The cheeks and chin are white, except for the faint grey tear under each eye, and the underparts are white with fine dark streaks. The bill is grey with a dark tip. The cere, eye-ring and legs are bright yellow.

Distribution

The Grey Falcon is found in low densities through much of the arid and semi-arid areas of Australia and has been recorded in all Australian mainland states and territories. The majority of records from the Northern Territory (NT) are from the southern half, but there are records all the way up to Darwin and also a record from Groote Eylandt.

Conservation reserves where reported: Finke National Park, Kakadu National Park, Nitmiluk National Park, Uluru National Park, Watarrka National Park and West MacDonnell Ranges National Park.



Known locations of the Grey Falcon

Ecology

Grey Falcons live in areas of lightly-timbered lowland plains, typically on inland drainage systems, where the average annual rainfall is less than 500 mm. Where they occur they are always at low densities and are mostly seen as singles or pairs. They use nests built by other species and prefer nests in the tallest trees along watercourses. Clutches are of one to four eggs. Nesting has been recorded from June to November, but in any one area may occur only in above-average rainfall years.

Grey Falcons hunt birds, often parrots and pigeons, typically from the air with a distinctive fast, level and low-to-the-ground hunting flight. They will also take insects on the wing. They many also pounce on mammals, reptiles and birds from a high perch.

Conservation assessment

The status of Grey Falcons in Australia was assessed in 2010 by Garnett et al. (2011). They considered the Australia-wide population to be in the order of 500 pairs and they considered the species to be Vulnerable.

The population of breeding birds in the NT must be fewer than the Australia-wide population, so the species qualifies as Vulnerable in the NT (under criterion D1), based on:

A very small total population size (<1 000).

Threatening processes

Threats to the Grey Falcon are not clearly defined. Habitat alteration and destruction through clearing for grazing and agriculture probably lead to declines in the species' southern and eastern ranges early last century, and confined them more to the arid parts of its range (Garnett et al. 2011). In the NT, such factors have probably been less influential.

Here landscape-scale changes in fire-regimes or grazing by feral or domestic herbivores may, in the long-term, reduce the availability of nesting trees and appropriate prey species.

Conservation objectives and management

Conservation objectives are to maintain stable populations of Grey Falcons across their range in the NT and to maintain successful breeding. The management required includes developing methods of assessing population trends and implementing long-term monitoring of populations.

Compiled by

Simon Ward

[updated December 2012]

References

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Appendix D – Ground Disturbance Permit System

All ground disturbance will be undertaken through a permitting system with sign-off required prior to ground disturbance occurring. If the area contains weeds, then they will be removed prior to vegetation clearance so that vegetative material is clean (i.e., free of weeds) and able to be mulched and reused directly on site.

The Ground Disturbance Permit (GDP) will have photographic evidence of before and after impacts. The area of disturbance will be kept to a minimum and no protected areas or buffer zones will be disturbed. The GDP will include:

- Disturbance Requirements (contractor, dates, works and dimensions)
- Area Assessment (restricted work areas, EIS approved area, within lease boundary, services, weeds controlled)
- Clearing Details (surveyed and demarked by flagging, supervisor of clearing, post clearing survey data).

The GDP will be issued by the Environmental Manager.

Appendix E – Risk Matrix

Consequence and likelihood for the risk assessment (section 3.2) were determined using the descriptions identified in Table E1 and Table E2 respectively. The risk matrix is shown in Table E3.

Table E1 Consequence Description

Consequence	Minor	Minor environmental impact. Impacts are contained on-site and short term in nature. No detrimental effect on the environment.
	1	Minor repairable damage to common historic structures or sites. No disturbance of cultural heritage sites. Minor local habitat modification and / or lifecycle disruption for a listed species. No loss of individuals of listed species. Negligible soil impact. Chemical concentrations are above background but below EILs. No detectable change to background water quality. No exceedance of background and applicable Water Quality guidelines.
	Moderate	Moderate, unplanned localised environmental impact (may be of a temporary nature) or discharge contained on-site or with negligible off-site impact.
	2	Moderate but repairable damage to important historic structures or sites of cultural importance. Moderate local habitat modification and / or lifecycle disruption for a listed species. Moderate local decrease in size of population(s) of listed species. Localised soil impact. Low level <2 times exceedance of EILs. Local short-term moderate exceedance of background and applicable Water Quality guidelines.
	Significant	Substantial, unplanned environmental impact contained on-site or minor impact that is off-site.
	3	Considerable damage or infringement to sensitive historic structures or sites of cultural significance. Substantial local habitat modification and / or lifecycle disruption for a listed species. Moderate local decrease in size of population(s) of listed species. Localised long term or widespread short-term soil impact. Chemical concentrations 2-5 times EILs. Local long-term or widespread short-term exceedance of background and applicable Water Quality guidelines.
	Major	Major or widespread, unplanned environmental impact on or off-site. Could include substantial pollutant discharges. Significant resources required to respond and rehabilitate.
	4	Major damage or infringement to sensitive historic structures or sites of cultural significance. Moderate regional habitat modification and / or lifecycle disruption for a listed species. Substantial local decrease in size of population(s) of listed species. Widespread and / or long-term impact to soils. Chemical concentrations 5-10 times EILs. Local, permanent or widespread, long-term exceedance of background and applicable Water Quality guidelines.
	Critical	Extensive long-term environmental harm or harm that is very widespread. Could include extensive pollutant discharges. Impacts permanent or unlikely to be reversible within 10 years.
	5	Unsalvageable and permanent damage to sensitive historic structures or sites of cultural significance. Substantial regional habitat modification and / or lifecycle disruption for a listed species. Moderate or substantial regional decrease in size of population(s) of listed species. Irreversible and / or extensive impact to soils. Chemical concentrations >10 times the ecological investigation levels (EILs). Widespread, permanent exceedance of background and applicable Water Quality guidelines.

Table E2 Likelihood Description

Likelihood	Rare	Unlikely	Possible	Likely	Almost Certain
	1	2	3	4	5
Description	The event may occur only in exceptional circumstances.	The event could occur very occasionally.	The event may occur.	The event will probably occur.	The event is expected to occur in most circumstances.
Occurrence Intervals	>10 years	5 – 10 years	2 – 5 years	1 – 2 years	<1 year

Table E3 Risk Matrix

			Severity of Consequence				
			Critical	Major	Significant	Moderate	Minor
			5	4	3	2	1
Likelihood of Consequence	Almost Certain	5	Extreme	Extreme	High	High	Medium
	Likely	4	Extreme	High	High	Medium	Medium
	Possible	3	Extreme	High	Medium	Medium	Low
	Unlikely	2	High	Medium	Medium	Low	Very Low
	Rare	1	Medium	Medium	Low	Low	Very Low

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Appendix J

Surface Water Data



			Anningie Creek Road	Anningie Creek Main Rd	Anningie Stirling Station	Hanson River Crossing	Stirling Swamp
Parameter	Unit	Environmental Quality Limit	17/01/17	17/01/17	17/01/17	17/01/17	17/01/17
TOC							
Total Organic Carbon (Filtered)	mg/L	5	-	-	-	-	-
Unassigned							
CO2 (Free) (Filtered)	mg/L	5	-	-	-	-	-
Dissolved Organic Carbon (Filtered)	mg/L	5	-	-	-	-	-
Field Parameters							
Turbidity (Filtered)	NTU	0.1	-	-	-	60.2	-
Inorganics							
Sulfate as SO4 - Turbidimetric (Filtered)	mg/L	1	-	-	-	<1	-
Electrical conductivity (lab) (Filtered)	µS/cm	1	-	-	-	49	-
Hydroxide as CaCO3 (Filtered)	mg/L	1	-	-	-	-	-
pH (Lab) (Filtered)	pH Units	0.01	-	-	-	7.22	-
Silica (Filtered)	µg/L	100	-	-	-	-	-
Total Dissolved Solids (Filtered)	mg/L	10	-	-	-	-	-
Total Dissolved Solids (calculated from EC) (Filtered)	mg/L	1	-	-	-	32	-
Total Suspended Solids (Filtered)	mg/L	1	-	-	-	36	-
Metals							
Aluminium (Filtered)	mg/L	0.05	-	-	-	-	-
Arsenic (Filtered)	mg/L	0.001	0.002	0.002	0.002	<0.001	0.003
Barium (Filtered)	mg/L	0.001	0.014	0.026	0.014	0.016	0.038
Beryllium (Filtered)	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (Filtered)	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	0.14
Cadmium (Filtered)	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (III+VI) (Filtered)	mg/L	0.001	0.001	0.004	0.002	0.002	0.004
Cobalt (Filtered)	mg/L	0.001	<0.001	0.002	<0.001	<0.001	0.002
Copper (Filtered)	mg/L	0.001	0.004	0.019	0.003	0.002	0.005
Iron (Filtered)	mg/L	0.05	-	-	-	-	-
Lead (Filtered)	mg/L	0.001	0.001	0.003	<0.001	0.001	0.003
Manganese (Filtered)	mg/L	0.001	0.02	0.04	0.023	0.027	0.195
Mercury (Filtered)	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel (Filtered)	mg/L	0.001	0.001	0.003	0.001	0.001	0.003
Selenium (Filtered)	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium (Filtered)	mg/L	0.005	-	-	-	-	-
Uranium (Filtered)	mg/L	0.005	-	-	-	-	-
Vanadium (Filtered)	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	0.01
Zinc (Filtered)	mg/L	0.005	0.015	0.084	<0.005	<0.005	0.015
Alkalinity							
Alkalinity (Carbonate as CaCO3) (Filtered)	mg/L	1	-	-	-	<1	-
Alkalinity (Hydroxide as CaCO3) (Filtered)	mg/L	1	-	-	-	<1	-
Alkalinity (total as CaCO3) (Filtered)	mg/L	1	-	-	-	25	-
Bicarbonate Alkalinity as CaCO3 (Filtered)	mg/L	1	-	-	-	25	-
Hardness as CaCO3 (Filtered)	mg/L	1	21	31	17	12	68
Biological							
Plate Count (36°C) (Filtered)	CFU/mL	1	-	-	-	-	-
Coliform (Filtered)	cfu/100 ml	1	-	-	-	-	-
E. Coli (Filtered)	cfu/100 ml	1	-	-	-	-	-
Major Ions							
Fluoride (Filtered)	mg/L	0.1	-	-	-	0.1	-

	Calcium (Filtered)	mg/L	0.5	5	9	5	3	14
	Chloride (Filtered)	mg/L	1	-	-	-	3	-
	Magnesium (Filtered)	mg/L	0.5	2	2	1	1	8
	Anions Total (Filtered)	meq/L	0.01	-	-	-	0.58	-
	Potassium (Filtered)	mg/L	0.5	4	7	3	3	15
	Sodium (Filtered)	mg/L	0.5	8	5	7	6	35
	Cations Total (Filtered)	meq/L	0.01	-	-	-	0.57	-
	Sulphate (Filtered)	mg/L	1	-	-	-	-	-
	Ionic Balance (Filtered)	%	0.01	-	-	-	1.25	-
Nutrients								
	Ammonia as N (Filtered)	mg/L	0.01	0.02	0.03	0.01	0.02	0.11
	Nitrate (as N) (Filtered)	mg/L	0.01	-	-	-	<0.01	-
	Nitrite (as N) (Filtered)	mg/L	0.01	-	-	-	<0.01	-
	Nitrite + Nitrate as N (Filtered)	mg/L	0.01	0.07	0.04	0.04	<0.01	<0.01
	Phosphate total (P) (Filtered)	µg/L	50	-	-	-	-	-
	Reactive Phosphorus as P (Filtered)	µg/L	10	-	-	-	20	-
	Sulphate as S (Filtered)	mg/L	5	-	-	-	-	-