

# Terrestrial Ecology Report

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# **EASTERN LEASES PROJECT**

## **Terrestrial Ecology Assessment Report**

For:

**Hansen Bailey on behalf of South32 Pty Ltd**

May 2015



**PO Box 2474  
Carlingford Court 2118**



**Report No. Q14002RP1**

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The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

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Version	Date Issued	Amended by	Details

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Approved by: Dr David Robertson

Position: Director

Signed: *David Robertson*

Date: 15 May, 2015

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## Glossary of Terms

AEP	Annual Exceedance Probability
ALC	Anindilyakwa Land Council
ALRA	<i>Aboriginal Land Rights Act (Northern Territory) 1976</i>
ANOSIM	Analysis of Similarity: a statistical analysis that tests whether there are significant differences between datasets from two or more sample groups
AOS	Assessments of Significance
API	Aerial Photograph Interpretation
CAMBA	China–Australia Migratory Bird Agreement
DBH	Diameter at Breast Height.
Disturbance footprint	The area of land proposed to be disturbed by the project
DotE	Commonwealth Department of the Environment
EA Act	<i>Environmental Assessment Act</i>
Eastern Leases	ELR28161 and ELR28162
EIS	Environmental Impact Statement
ELR	Exploration Licence in Retention
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPBC Act Environmental Offsets Policy	<i>EPBC Act Environmental Offsets Policy 2012</i>
ESCP	Erosion and Sediment Control Plan
GEMCO	Groote Eylandt Mining Company Pty Ltd
GIS	Geographic Information System
GPS	Global Positioning System
InfoNet	Northern Territory NRM InfoNet database
IR camera	Infra-red camera
JAMBA	Japan–Australia Migratory Bird Agreement
LBMP	Land and Biodiversity Management Plan
LC	Least Concern
littoral	Refers to environments that are within proximity of the sea or the sea shore (e.g. “littoral rainforests” or “littoral zone”)
Locality	Area within 20 km radius of the project site
MDS	Multidimensional Scaling. This is a graphical means of representing the level of similarity between two or more sample groups
mesic	Refers to moderate – high moisture environments (such as rainforests) and the plants that are associated with such environments (e.g. “mesic vegetation” or “mesic plants”)



microhabitat	Refers to very small, specialised habitats, such as a clump of grass or a space between rocks
MM Act	Northern Territory <i>Mining Management Act</i>
MNES	'Matters of National Environmental Significance' that are listed by the EPBC Act
MU	Map Unit
Native Title Act	Commonwealth <i>Native Title Act 1993</i>
NRIC	National Resource Information Centre
Northern EL	Northern Eastern Lease (ELR28161)
Northern Territory Fauna Survey Guidelines	<i>Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey</i> (NRETAS, 2011)
NT DLRM	Northern Territory Department of Land Resource Management
NT EPA	Northern Territory Environment Protection Authority
NVIS	National Vegetation Information Systems. The NVIS is a comprehensive data system that provides information on the extent and distribution of vegetation types in Australian landscapes. It is an ongoing collaborative initiative between the Australian and state and territory governments to manage national vegetation data to help improve vegetation planning and management within Australia.
PFC	Projective Foliage Cover: the percentage of ground that is shaded by a vertical projection of the foliage of plants
physiographic	Refers to the features and attributes of the earth's land surface
PMST	Protected Matters Search Tool
project site	the area comprising the Eastern Leases and the proposed haul road
RNE	Register of National Estate
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Populations and Communities – now the DotE
SIMPER	Similarity Percentages: a statistical analysis that compares the contribution of species to an observed similarity between two or more sample groups
Southern EL	Southern Eastern Lease (ELR28162)
sp.	Singular of 'species' and used when the species was unable to be identified
spp.	Plural of 'species' and used when referring to a number of species within a genus
TEC	Threatened Ecological Community
the project	the Eastern Leases Project
TOR	Terms of Reference
TPWC Act	<i>Territory Parks and Wildlife Conservation Act</i>
TSMF	Threatened Species Management Plan





# Chapter 1

## Introduction

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Cumberland Ecology was commissioned by Hansen Bailey on behalf of BHP Billiton Manganese Australia Pty Ltd to prepare a terrestrial ecology assessment report as part of the Environmental Impact Statement (EIS) for the Eastern Leases Project (the 'project').

An EIS is being prepared in accordance with the requirements of the Northern Territory *Environmental Assessment Act* (EA Act) and to support an application for approval from the Commonwealth Department of the Environment (DotE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Terms of Reference (TOR) for the EIS were issued by the Northern Territory Environment Protection Authority (NT EPA) in September 2014. The Northern Territory's EIS process for the project has been accredited under an agreement between the Commonwealth and the Northern Territory under section 45 of the EPBC Act, following determination of the project as a 'controlled action' (EPBC 2014/7228).

### 1.1 Purpose

This terrestrial ecology assessment provides ecological information for the EIS being prepared in order to support approval of the project. The purpose of this report is to document the findings of a terrestrial ecological assessment of the project site (see **Figure 1**) and to assess the impacts of the project on the terrestrial biodiversity values present. Biodiversity values include threatened species, populations and ecological communities protected under Territory and Commonwealth legislation.

Specifically, the objectives of this terrestrial ecology assessment report are to:

- Describe and map vegetation communities of the project site;
- Identify and map the location of threatened flora and fauna species;
- Assess the likelihood as to whether threatened flora and fauna species could occur within the project site;
- Describe the presence or likely occurrence of introduced and invasive species (both flora and fauna) in the region;
- Describe the types and extent of potential impacts arising from the project; and
- Describe avoidance, mitigation and offset measures proposed to manage impacts.



An aquatic ecology assessment has been undertaken separately and is presented in the EIS Aquatic Ecology Report.

## 1.2 Project Description

The project proponent is the Groote Eylandt Mining Company (GEMCO), which has two shareholders, namely South32 Pty Ltd (60%) and Anglo Operations (Australia) Pty Ltd (40%). BHP Billiton Manganese Australia Pty Ltd was previously a shareholder in GEMCO, however its interest is now represented by South32.

The project involves the development of a number of open cut mining areas to the east of the existing GEMCO manganese mine on Groote Eylandt in the Gulf of Carpentaria, approximately 650 km south-east of Darwin (**Figure 1**). The proposed additional mining areas are located on the Eastern Leases, which are two Exploration Licences in Retention (ELRs). ELR28161 is termed the Northern Eastern Lease (Northern EL) and ELR28162 is termed the Southern Eastern Lease (Southern EL).

The Eastern Leases are located 2 km east of the existing GEMCO mine at the closest point. The township of Angurugu is located approximately 6 km to the north-west of the Eastern Leases, and is the closest residential community (**Figure 2**). The Eastern Leases are located on Aboriginal land, scheduled under the *Aboriginal Land Rights (Northern Territory) Act 1976* (ALRA). The land within the Eastern Leases comprises natural bushland, with the Emerald River and a small section of the Amagula River traversing the Northern EL and Southern EL respectively.

The project involves:

- Developing a number of open cut mining areas (termed “quarries”) within the Eastern Leases and mining manganese ore by the same mining methods that are in use at the existing GEMCO mine;
- Constructing limited mine related infrastructure in the Eastern Leases (dams, water fill points, crib hut, truck park up areas and lay down storage areas); and
- Transporting the ore by truck on a new haul road to be constructed between the existing GEMCO mine and the Eastern Leases.

Ore will be processed at the concentrator at the existing GEMCO mine and the concentrate would be transported to market via the existing port (**Figure 2**). No changes or upgrades to the existing GEMCO mine facilities are required as a result of the project. Ore mined from the Eastern Leases will supplement production from the existing GEMCO mine, but the project will not increase GEMCO’s annual production rate of approximately 5 Million tonnes per annum of product manganese. The EIS does not assess the environmental impact of operations within the existing GEMCO mine, given that these operations are subject to existing environmental approvals, and will not be altered by the project.



The project site for the purposes of the EIS is the Northern and Southern ELs and the new section of haul road linking the Eastern Leases to the existing GEMCO mine. The project site is approximately 4,600 ha.

Mining in the Eastern Leases would take place concurrently with the operation of the existing GEMCO mine. According to current planning, construction in the Northern EL would commence in 2017 and mining activities would commence in 2018. Construction in the Southern EL is scheduled to commence approximately four years later in 2022 and mining would then take place in both of the tenements until approximately 2031. This equates to a total of 13 years of mining operations (i.e. mining of ore).

### 1.3 Island and Regional Context

The project site is located on Groote Eylandt, the third largest island off the Australian mainland. It is part of an archipelago to the east of Arnhem Land and is rated as having international significance because of the integrity of its flora and fauna. According to the Northern Territory Government (NRETAS, 2009), Groote Eylandt and other islands in the archipelago have conservation values including:

- Nationally and internationally significant sites for nesting seabirds and turtles;
- Approximately 900 species of vascular plants and 330 vertebrates; and
- Known occurrences of a suite of threatened species including the nationally listed Northern Hopping-mouse (*Notomys aquilo*), Brush-tailed Rabbit-rat (*Conilurus penicillatus*) and Northern Quoll (*Dasyurus hallucatus*).

The main reason for the conservation significance of the island is thought to be the absence or near absence of key threatening processes that are operating on the nearby Australian mainland (NRETAS, 2009). Of particular note, many of the feral animals that have impacted native flora and fauna on the mainland, are absent from Groote Eylandt. In particular, feral cattle (*Bos taurus*), horses (*Equus caballus*), donkeys (*Equus asinus*), Water Buffalo (*Bubalus bubalis*), the Cane Toad (*Rhinella marina*), Rusa Deer (*Cervus timorensis*), Feral Pig (*Sus scrofa*), and the European Red Fox (*Vulpes vulpes*) are not established on the island.

Groote Eylandt is located in the Groote Sub-region of the Arnhem Coast Bioregion (SEWPaC, 2012c). The Arnhem Coast Bioregion comprises a coastal strip extending from just east of the Cobourg Peninsula to just north of the township of Numbulwar in south eastern Arnhem Land, and includes many offshore islands including Groote Eylandt (**Figure 3**). The Arnhem Coast Bioregion has a tropical monsoonal climate with a distinct wet and dry season, and high temperatures throughout the year (DEWHA, 2008).

The vegetation within the Arnhem Coast Bioregion is characterised by eucalypt woodlands, monsoon vine forests and coastal communities, such as mangroves (DEWHA, 2008). Coastal vegetation includes well developed heathlands, mangroves and saline flats, with some floodplain and wetland areas (DLRM, 2014a). Inland from the coast, the dominant



vegetation type is eucalypt tall open forest, typically dominated by *Eucalyptus miniata* (Darwin Woollybutt) and *Eucalyptus tetradonta* (Darwin Stringybark), with smaller areas of monsoon rainforest and eucalypt woodlands (DLRM, 2014a). Well-developed coastal dune systems and rugged Cretaceous sandstone areas have been recorded on Groote Eylandt (DLRM, 2014a).

The bioregion is located entirely within Aboriginal land (DEWHA, 2008). Land uses within the bioregion include bauxite and manganese mining, as well as tourism (DEWHA, 2008). No national parks occur within the bioregion (DLRM, 2014a).

## 1.4 Description of the Project Site

The project site is located in the upper catchments of the Emerald, Amagula and Angurugu Rivers. It is characterised by areas of flat to undulating sand plains surrounded by low hills of outcropping quartzitic rock.

The vegetation and habitats within the project site are almost pristine and are strongly influenced by topography and drainage. Eucalypt open forests and woodlands dominate the well-drained areas of the project site with Melaleuca-dominated vegetation occurring in swampy and riparian areas. Fire also plays a very significant role in determining vegetation composition and the majority of the site except for minor protected pockets is regularly burnt by the traditional owners.

The project site provides a range of forest, woodland and wetland habitat for fauna species and is contiguous with native vegetation on all sides that can be utilised by fauna species to connect to adjacent areas of habitat.

## Regulatory Framework

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### 2.1 Commonwealth Legislation and Policies

#### 2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act is the Australian Government's principal piece of environmental legislation and is administered by DotE. It is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, endangered ecological communities, migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened flora and fauna, identifies key threatening processes and provides for the preparation of recovery plans for threatened flora, fauna and communities.

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES (including nationally threatened ecological communities and species, and listed migratory species) is termed a Controlled Action and is subject to assessment and approval under the EPBC Act.

The project was deemed a Controlled Action on 1 July 2014 with the controlling provisions for the project being listed threatened species and communities (Section 18 and 18A) and listed migratory species (Sections 20 and 20A). The project will be assessed through an accredited assessment process under the EA Act.

#### 2.1.2 *EPBC Act Environmental Offsets Policy*

Under the *EPBC Act Environmental Offsets Policy 2012* (EPBC Act Environmental Offsets Policy), environmental offsets are actions taken to counterbalance significant residual impacts on MNES. Offsets are used as a last resort in instances where an action will give rise to residual impacts, even after the application of management measures.

The EPBC Act Environmental Offsets Policy came into force in October 2012 and provides guidance on the role of offsets in environmental impact assessments and how DotE considers the suitability of a proposed offset package (SEWPaC, 2012b).

According to the policy, an offsets package is a “*suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project*” (SEWPaC, 2012b). It can comprise a combination of direct offsets and other compensatory measures.



Direct offsets, (e.g. land based offsets) are those actions that provide a measurable conservation gain for an impacted protected matter. Under the EPBC Act Environmental Offsets Policy a conservation gain may be achieved by (SEWPaC, 2012b):

- Improving existing habitat for the protected matter;
- Creating new habitat for the protected matter;
- Reducing threats to the protected matter;
- Increasing the values of a heritage place; and/or
- Averting the loss of a protected matter or its habitat that is under threat.

Typically, direct offsets involve the acquisition of land, as well as the maintenance and improvement of that land. Targeted positive conservation actions towards the impacted protected matter is required to be demonstrated, and may include such actions as:

- Rehabilitating existing vegetation to improve condition;
- Revegetating environmentally degraded land; and/or
- Protecting existing good or better quality habitat.

Other compensatory measures are those actions that do not directly offset the impacts on the protected matter, but are anticipated to lead to benefits for the impacted protected matter (SEWPaC, 2012b). The EPBC Act Environmental Offsets Policy provides for compensatory measures such as research and funding. Compensatory measures must:

- Endeavour to improve the viability of the impacted protected matter, for example:
  - Signage in key areas to educate the public regarding the risks to a threatened animal; or
  - Research into effective re-vegetation techniques for a threatened ecological community;
- Be targeted toward key research/education activities as identified in the relevant Commonwealth approved recovery plan, threat abatement plan, conservation advice, ecological character description, management plan or listing document;
- Be undertaken in a transparent, scientifically robust and timely manner;
- Be undertaken by a suitably qualified individual or organisation in a manner approved by the department; and
- Consider best practice research approaches.

A minimum of 90% of the offset requirements for any given impact must be met through direct offsets. Deviation from the 90% direct offset requirement will only be considered by



DotE in circumstances where it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package, or scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter (SEWPaC, 2012b).

### **2.1.3 International Treaty Obligations on Migratory Species**

Australia is signatory to several agreements relating to migratory species. Migratory species listed under the following agreements and conventions are protected in Australia through being listed as MNES (Migratory Controlling Provision) under the EPBC Act:

- China–Australia Migratory Bird Agreement (CAMBA);
- Japan–Australia Migratory Bird Agreement (JAMBA);
- Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA); and
- Convention on the conservation of migratory species of wild animals (Bonn Convention).

The CAMBA and JAMBA agreements list terrestrial, water and shorebird species which migrate between Australia and the respective countries. In both cases the majority of listed species are shorebirds (DotE, 2014a).

Both agreements require the parties to protect migratory birds by:

- Limiting the circumstances under which migratory birds are taken or traded;
- Protecting and conserving important habitats;
- Exchanging information; and
- Building cooperative relationships.

The JAMBA agreement also includes provisions for cooperation on the conservation of threatened birds. Australian government and non-government representatives meet every two years with Japanese and Chinese counterparts to review progress in implementing the agreements and to explore new initiatives to conserve migratory birds (DotE, 2014a).

The ROKAMBA formalises Australia's relationship with the Republic of Korea in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (DotE, 2014a).

In addition to these bilateral agreements, Australia is also a signatory of the Bonn Convention. This convention aims to conserve terrestrial, aquatic and avian migratory species throughout their range (CMS, 2015).



## **2.2 Northern Territory Legislation and Guidelines**

### **2.2.1 Mining Management Act**

The *Mining Management Act* (MM Act) is an Act established to ensure the development of the Northern Territory's mineral resources in accordance with environmental standards consistent with best practice in the mining industry (MM Act, Section 3(a)). The MM Act aims to protect the environment through establishing a system that provides for the authorisation of mining activities, the management of mining sites, the provision of economic and social benefits to communities affected by mining activities, and for related purposes. Any company that proposes to undertake works that would cause "substantial disturbance" is required to have an Authorisation. The Mining Environmental Compliance Group in the Northern Territory Department of Mines and Energy is responsible for issuing Authorisations for operational activities on mining tenements. The group is also responsible for ensuring there is a transparent system in place for remediation securities (i.e. closure and decommissioning provisions involving the rehabilitation of mining leases or to rectify environmental harm caused by mining activities) and ensuring operators comply with approved mining management plans. The project will require an Authorisation under the MM Act, and this Authorisation can only be granted once the EIS process under the EA Act has been completed.

### **2.2.2 Environmental Assessment Act**

The environmental assessment process is administered under the Northern Territory EA Act and its subordinate *Environmental Assessment Administrative Procedures*. The Act and Procedures establish the framework for the assessment of potential or anticipated environmental impacts of development. The object of the Act is to ensure that matters affecting the environment to a significant extent are fully examined and taken into account in decisions by the Northern Territory Government. In the Northern Territory, the NT EPA is responsible for the implementation of the environmental assessment process.

The scale and complexity of a proposed development and the significance of potential impacts will determine if assessment is at the level of a Public Environmental Report or EIS. In addition to assessing the potential impacts, the assessment process also evaluates the effectiveness of the proposed safeguards to mitigate these impacts and recommends actions to ensure the construction and operational phases of a project can be managed in an environmentally sound manner. The NT EPA has determined that an EIS is the required level of assessment for the project.

### **2.2.3 Territory Parks and Wildlife Conservation Act 2006**

The *Territory Parks and Wildlife Conservation Act* (TPWC Act) is the primary piece of legislation for managing the protection and conservation of biodiversity, and the sustainable use of wild populations (of predominantly terrestrial life) in the Northern Territory. The Act is administered by the Northern Territory Department of Land Resource Management (NT DLRM).





The TPWC Act makes provision for the study, protection, conservation and sustainable utilisation of wildlife throughout the Northern Territory. This legislation covers the classification and management of wildlife; classification and control of feral animals; permits for taking wildlife and entering land; designation and management of protected areas, including joint management with Traditional Owners and mining; and private sanctuaries.

The management of wildlife under the TPWC Act is to be carried out in accordance with the Principles of Management (Section 31 of the TPWC Act), which promote:

- (a) the survival of wildlife in its natural habitat;*
- (b) the conservation of biological diversity within the Territory;*
- (c) the management of identified areas of habitat, vegetation, ecosystem or landscape to ensure the survival of populations of wildlife within those areas;*
- (d) the control or prohibition of:*
  - (i) the introduction or release of prohibited entrants into the Territory; and*
  - (ii) any other act, omission or thing that adversely affects, or will or is likely to adversely affect, the capacity of wildlife to sustain its natural processes;*  
*and*
- (e) the sustainable use of wildlife and its habitat.*

Under the TPWC Act, threatened flora and fauna species in the Northern Territory are classified under the following conservation categories:

- Extinct;
- Extinct in the Wild;
- Critically Endangered;
- Endangered;
- Vulnerable;
- Near Threatened;
- Least Concern;
- Data Deficient; and
- Not Evaluated.

These categories and associated assessment criteria are aligned with the classification system and criteria developed by the International Union for the Conservation of Nature for determining the conservation status of species.



Under the TPWC Act, species are considered as ‘threatened’ wildlife if they are classified as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable and are assigned protected wildlife status. The categories utilised under the TPWC Act are independent of the listing of wildlife under the EPBC Act as they relate only to their occurrence within the Northern Territory.

#### **2.2.4 Weeds Management Act 2001**

The *Weeds Management Act* (WM Act) makes provision for the control and eradication of declared weeds in the Northern Territory. The Act is administered by the NT DLRM.

Weeds that have been identified to have an impact on the Territory’s economic, environment, cultural and social values are declared under the WM Act. A weed may be declared as:

- Class A: To be eradicated;
- Class B: Growth and spread to be controlled; and
- Class C: Not to be introduced to the Territory.

#### **2.2.5 Land Clearing Guidelines**

The Northern Territory Land Clearing Guidelines (NRETAS, 2010) play a role in guiding good land development practice in the Northern Territory by establishing standards for native vegetation clearing. The guidelines recognise that decisions to clear native vegetation are significant because clearing will lead to at least some change in landscape function. The guidelines seek to manage clearing in a way that promotes the greatest possible net benefit from use of land cleared of native vegetation.

The guidelines are administered by the NT DLRM. The guidelines are recognised formally under the Northern Territory *Planning Act* and referenced in the Northern Territory Planning Scheme.

For development applications to which the *Planning Act* applies, applicants who wish to clear native vegetation must demonstrate how they have considered the guidelines. The consent authority must have regard to the guidelines and ensure that an application to clear native vegetation is consistent with them.

Mining developments, however, are controlled by the *Mining Management Act* rather than the *Planning Act*. Mining applications are not, therefore, required to formally consider the Land Clearing Guidelines. Nevertheless, there are sections of the guidelines that provide useful information regarding the assessment of sensitive or significant vegetation types. These sections of the guidelines will be considered when assessing the environmental impacts of the project on sensitive communities.



### **2.2.6 Guidelines for Assessment of Impacts on Terrestrial Biodiversity**

The Northern Territory *Guidelines for Assessment of Impacts on Terrestrial Biodiversity* (NT EPA, 2013) were developed so that proponents of developments:

- Have a clear understanding of what is required to undertake an assessment of a project's biodiversity impacts as required for a Public Environmental Report or EIS;
- Can focus the project's biodiversity assessments on significant impacts potentially caused by the project; and
- Provide information sufficient to allow planning for mitigation of potential impacts and future rehabilitation of a development site.

The development of the guidelines included consideration of the following Northern Territory legislation:

- *Planning Act*;
- *Water Act*;
- *Biological Control Act*;
- TPWC Act;
- *Marine Pollution Act*;
- *Waste Management and Pollution Control Act*; and
- WM Act.

The guidelines specify which information and assessments are required for vegetation, flora and fauna. The guidelines recognise the need for a thorough assessment of impacts and the consequences to biodiversity values. Assessment of the significance of impacts of a project is done through risk assessment procedures, taking into account that avoidance and mitigation measures have been implemented. The guidelines also present the terrestrial vertebrate survey methods used by the NT DLRM.

### **2.2.7 Northern Territory Offset Guidelines on Environmental Offsets and Associated Approval Conditions**

The objective of the *Northern Territory Guidelines on Environmental Offsets and Associated Approval Conditions* (NTEPA, 2013) is to foster coordination of offsets and the conditioning of approval requirements that may be imposed under Commonwealth and Northern Territory legislation. The guidelines note the potential requirement for an environmental offset under the EPBC Act, EA Act, ALRA and the Commonwealth *Native Title Act 1993* (Native Title Act). The offset requirements under the EPBC Act are outlined within the EPBC Act Environmental Offsets Policy (see **Section 2.5**). At present, the EA Act contains no requirements for the provision of environment offsets or social or other community benefits



as part of an assessment or approval process. The NT EPA has no role in requiring, developing or managing environmental offsets, however the ALRA and the Native Title Act contain provision for negotiation with Land Councils regarding the use of Aboriginal lands or lands with Aboriginal interests which may entail the provision of environmental offsets.

As there is no formal offsetting policy under the EA Act, any offsets required for project-related impacts will be provided under the EPBC Act Environmental Offsets Policy.

# Methodology

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This section describes the methodology adopted for the terrestrial ecology studies. Investigations for the project entailed a review of relevant information and data produced for nearby areas of Groote Eylandt, followed by a wider literature review and database assessment and then targeted flora and fauna fieldwork. The methods used for each component are explained in more detail below.

Due to the size of the project site (4,582 ha), the approach was to conduct field surveys in strategic locations and extrapolate using high resolution aerial photography, geological maps and topographic maps. Prior to undertaking field surveys, appropriate permits were obtained from the Northern Territory Government. These included:

- A Permit to Interfere with Protected Wildlife (Permit number 51161);
- A Licence to Use Premises for Teaching or Research involving Wild Animals (Licence number 058); and
- An Animal Ethics Approval consistent with the Northern Territory *Animal Welfare Act*.

Permission to access the project site for the purpose of undertaking field surveys was obtained from the Anindilyakwa Land Council (ALC).

## 3.1 Desktop Assessment

### 3.1.1 Database Analysis

A database analysis was conducted through consultation of the DotE EPBC Protected Matters Search Tool (PMST) (DotE, 2014b) and the Northern Territory NRM InfoNet database (InfoNet) (DLRM, 2014d).

The EPBC PMST generated a list of potentially occurring MNES listed under the EPBC Act within a 20 km radius of the project site. The InfoNet search was used to generate records of flora and fauna, including threatened species, known to occur within a 20 km radius of Groote Eylandt. The abundance, distribution and age of records generated within the search areas provided supplementary information for the assessment of likelihood of occurrence of those threatened species within the project site. Consideration was also given to species listed in the EIS TOR for the project (NT EPA, 2014), as well as the list of threatened and



migratory species listed under the EPBC Act provided through direct consultation with the DotE Regional Assessment Branch.

### 3.1.2 Literature Review

Available literature on the project site and Groote Eylandt was reviewed, including available government data and in-house reports made available from GEMCO. Numerous ecological studies have been conducted within and in proximity to the project site, including detailed flora and fauna investigations. Key documents reviewed for this terrestrial ecology assessment included:

- URS Australia Pty Ltd (2012): Flora and Fauna Surveys of Western Groote Eylandt;
- G. Webb Pty Limited (1992): Flora and Fauna Surveys on the Western Side of Groote Eylandt, N.T. (1991-92);
- Brocklehurst, P. and I. Cowie (1992): Flora Survey of the GEMCO Mining Lease on the Western Side of Groote Eylandt, Northern Territory; and
- Langkamp, P. J., D. H. Ashton, and M. J. Dalling (1981): Ecological gradients in forest communities on Groote Eylandt, Northern Territory, Australia.

Of these documents, the key datasets drawn upon within this assessment are from URS (2012) and Webb (1992). The study areas for these surveys are shown in **Figure 4**. Numerous other reports were consulted during the preparation of this terrestrial ecology assessment report including those presenting the results of targeted surveys (Ward, 2006a; Ward, 2006b; Ward, 2007a; Ward, 2007b; Firth, 2008; Smith, 2009a; Smith, 2009b; Rankmore, 2011), pre-clearing/exploration surveys (Coffey Environments Pty Ltd, 2010; EMS, 2014b), impact assessment reports (EMS, 2008; EMS, 2012; LES, 2013), general reporting of species groups on Groote Eylandt (Davies and Tyler, 1986; Noske and Brennan, 2002) and remote sensing of vegetation (Crase and Hempel, 2005). A summary of the suite of previous survey reports utilised within this assessment is provided in **Table 3.1**.

A detailed review of threatened species information provided within the Threatened Species Information Sheets published by the NT DLRM and the Species Profiles and Threats Database published by DotE was also undertaken as part of this assessment.

The information collected during the literature review guided the field surveys undertaken for this ecological assessment. Surveys undertaken for this assessment built upon relevant recent data collected from nearby areas that were in either the same or similar landscapes or habitats. Information within the literature reviewed was also utilised in determining the likelihood of threatened species occurring within the project site and assessing the potential impacts of the project.

As part of the literature review, a comprehensive review of applicable Northern Territory and Commonwealth environmental legislation and guidelines was undertaken to ensure that the field survey methodology was appropriate. Key documents considered include:



- Brocklehurst, P., Lewis, D., Napier, D., Lynch, D. (2007) Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping. Technical Report No. 02/2007D;
- NRETAS (2010) Land Clearing Guidelines;
- Northern Territory EPA (2013) Guidelines for Assessment of Impacts on Terrestrial Biodiversity;
- NRETAS (2011) Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey;
- SEWPaC (2011b) Survey guidelines for Australia's threatened mammals; and
- DEWHA (2010) Survey guidelines for Australia's threatened birds.

**Table 3.1 Summary of Previous Survey Reports Utilised within this Assessment**

Document Title	Author	Date	Purpose	Location	Information Utilised within this Report
Ecological gradients in forest communities on Groote Eylandt, Northern Territory, Australia.	Langkamp, P.J., D.H. Ashton and M.J. Dalling.	1981	Botanical examination of the natural patterns and ecology of forest and woodland on Western Groote Eylandt, particularly in areas where manganese deposits are located on Western Groote.	Existing GEMCO Mine and Eastern Leases (see Figure 1).	Explains the patterns of forest and woodland floristic and structural variation in relation to soils, topography and drainage.
Flora Survey of the GEMCO Mining Lease on the Western Side of Groote Eylandt, Northern Territory.	P. Brocklehurst and I. Cowie.	1992	Provide baseline data on the flora and fauna within the GEMCO mineral leases and adjoining areas.	Existing GEMCO Mine and Eastern Leases (see Figure 1).	The document provided information on: - Distribution and descriptions of vegetation communities. - Flora and fauna diversity. - Fauna habitats present.
Flora and Fauna Surveys on the Western Side of Groote Eylandt, N.T. (1991-92).	G. Webb Pty Limited.	1992	Provide baseline data on the flora and fauna within the GEMCO mineral leases and adjoining areas.	Existing GEMCO Mine and Eastern Leases (see Figure 1). Figure 4 shows the study area for Webb (1992).	The document provided information on: - Distribution and descriptions of vegetation communities. - Flora and fauna diversity. - Fauna habitats present. - Occurrence of threatened fauna species (although no maps of occurrence were provided in the Webb report).



Document Title	Author	Date	Purpose	Location	Information Utilised within this Report
Object based land cover mapping for Groote Eylandt: a tool for reconnaissance and land based surveys.	Cruse, B. and Hempel, C.	2005	Provide a land cover map by spatial analysis, which integrates remotely sensed imagery with Geographic Information Systems. Intended to be a useful tool for selection of sites for vegetation investigation.	Entire Groote Eylandt.	A map of broad land cover types which has been used as the basis for mapping broad habitats for threatened species in the current study.
Northern Hopping Mouse <i>Notomys aquilo</i> - ALC Ranger Report April 2006.	S. Ward.	2006	To examine ways to monitor the Northern Hopping-mouse.	Eningkirra and Yanbakwa (see Figure 2).	The document provided background information on: - Small terrestrial mammals occurring on Groote Eylandt. - Survey techniques for the Northern Hopping-mouse. This document provided locations of records of potential Northern Hopping-mouse spoils.
Northern Hopping Mouse <i>Notomys aquilo</i> - ALC Ranger Report November 2006.	S. Ward	2006	To examine ways to monitor the Northern Hopping-mouse.	Enungwadena (Kings Crossing) and the road to Dalumba Bay and Yingakwumanja (see Figure 2).	The document provided background information on: - Small terrestrial mammals occurring on Groote Eylandt. - Survey techniques for the Northern Hopping-mouse. This document provided locations of records of: - Northern Hopping-mouse. - Potential Northern Hopping-mouse spoils. - Brush-tailed Rabbit-rat.

Document Title	Author	Date	Purpose	Location	Information Utilised within this Report
Northern Hopping Mouse <i>Notomys aquilo</i> - ALC Ranger Report April-May 2007.	S. Ward.	2007	To examine ways to monitor the Northern Hopping-mouse.	Amalyikba Creek, Enungwadena (Kings Crossing) and the road to Dalumba Bay, Hempel Bay and tracks joining Umbakumba, Mamalingmanja Point (Picnic Beach) and Banyan Tree (see Figures 1 and 2).	The document provided background information on: - Small terrestrial mammals occurring on Groote Eylandt. - Survey techniques for the Northern Hopping-mouse This document provided locations of records of: - Northern Hopping-mouse. - Potential Northern Hopping-mouse spoils. - Brush-tailed Rabbit-rat.
Northern Hopping Mouse <i>Notomys aquilo</i> - ALC Ranger Report September 2007.	S. Ward.	2007	To examine ways to monitor the Northern Hopping-mouse.	Tracks joining Umbakumba, Mamalingmanja Point (Picnic Beach) and Banyan Tree, north east of Umbakumba and Enungwadena (Kings Crossing) and the road to Dalumba Bay (see Figures 1 and 2).	The document provided background information on survey techniques for the Northern Hopping-mouse. This document provided locations of records of potential Northern Hopping-mouse spoils.

Document Title	Author	Date	Purpose	Location	Information Utilised within this Report
Surveys for the Threatened Northern Hopping-mouse, Northern Quoll & Brush-tailed Rabbit-rat on GEMCO Eastern Exploration Leases (Groote Eylandt).	D. R. Firth.	2008	Undertake targeted surveys for the Northern Hopping-mouse, Northern Quoll and Brush-tailed Rabbit-rat.	Eastern Leases (see Figure 2).	This document provided locations of records of: - Potential Northern Hopping-mouse spoils. - Brush-tailed Rabbit-rat.
F3 Quarry Area Expansion, GEMCO Groote Eylandt. Terrestrial Fauna Assessment.	Ecological Management Services Pty Ltd.	2008	Assess the terrestrial vertebrate fauna species present within the proposed F3 Quarry expansion area and an additional area to the west.	F3 Quarry and adjacent area to west (see Figure 4)	The document provided background information on fauna assemblages within the GEMCO mineral leases This document provided locations of records of potential Northern Hopping-mouse spoils.
Seasonal detectability of Northern Hopping Mouse spoil heaps on Groote Eylandt.	D. J. Smith.	2009	Collect additional information about the seasonal visibility of Northern Hopping- mouse spoil heaps.	Eastern Leases (see Figure 2)	This document provided locations of records of potential Northern Hopping-mouse spoils.
Surveys for Northern Hopping-mouse, Northern Quoll and Brush-tailed Rabbit-rat across Groote Eylandt.	D. J. Smith.	2009	Undertake targeted surveys for the Northern Hopping-mouse, Northern Quoll and Brush-tailed Rabbit-rat.	Various locations across Groote Eylandt	The document provided background information on small terrestrial mammals occurring on Groote Eylandt This document provided locations of records of: - Potential Northern Hopping-mouse spoils. - Northern Quoll. - Brush-tailed Rabbit-rat.

Document Title	Author	Date	Purpose	Location	Information Utilised within this Report
Eastern Leases Pre-clearance Survey for Grootte Eylandt Mining Company.	Coffey Environments Pty Ltd.	2010	Pre-clearance surveys for Northern Hopping-mouse and collection of population characteristics through the excavation of spoil heaps, and targeted surveys for the Northern Hopping-mouse.	Eastern Leases (pre-clearing) and Quarries F3, G and D (targeted surveys) (see Figures 2 and 4).	The document provided background information on the suitability of using spoils to record the presence of the Northern Hopping-mouse. This document provided locations of records of: - Northern Hopping-mouse. - Potential Northern Hopping-mouse spoils.
Survey for Signs of Northern Hopping-mice on the GEMCO Eastern Leases.	D. B. Rankmore.	2011	Targeted survey for signs of the Northern Hopping-mouse.	Eastern Leases (Figure 2)	The document provided background information on surveys for the Northern Hopping-mouse.
Flora and Fauna Surveys of Western Groote Eylandt.	URS Australia Pty Ltd.	2012	Provide a comprehensive flora and fauna assessment across the GEMCO mineral leases.	Existing GEMCO Mine Figure 4 shows the study area for URS (2012).	The document provided information on: - Distribution and descriptions of vegetation communities. - Flora and fauna diversity. - Fauna habitats present. - Occurrence of threatened fauna species mentioned but not mapped by URS. - Faunal assemblages within mine rehabilitation areas.
Assessment of Northern Hopping Mouse ( <i>Notomys aquilo</i> ) Habitat Issues, A-South Expansion Area.	Ecological Management Services Pty Ltd.	2012	Provide a preliminary assessment of the potential for a proposed expansion area to support populations of the Northern Hopping-mouse.	West of the A South Quarry (see Figure 4).	The document provided information on mammal species known within the GEMCO mineral leases. This document provided locations of records of potential Northern Hopping-mouse spoils.

Document Title	Author	Date	Purpose	Location	Information Utilised within this Report
Eastern Leases ELR28161/ELR28162 Exploration Drilling Program: Northern Masked Owl/Northern Hopping Mouse Habitat Assessment June – July 2013.	Ecological Management Services Pty Ltd.	2013	Conduct surveys within the footprint of the proposed exploration drilling lines and pads within the Eastern Leases, targeting Masked Owl (northern) individuals and habitat and Northern Hopping-mouse burrows.	Eastern Leases (see Figure 2).	The document provided background information on nesting/roosting habitat features available for use by the Masked Owl (northern).  This document provided locations of records of: - Potential Northern Hopping-mouse spoils. - Brush-tailed Rabbit-rat. - Masked Owl (northern).
Eastern Leases ELR28161/ELR28162 Exploration Drilling Program: Northern Masked Owl/ Northern Hopping Mouse Habitat Assessment. August 2014.	Ecological Management Services Pty Ltd.	2014	Re-survey uncleared exploration drilling lines and pads in the Eastern Leases and identify Masked Owl (northern) roost/nest trees and Northern Hopping-mouse spoils.	Eastern Leases (see Figure 2).	The document provided background information on nesting/roosting habitat features available for use by the Masked Owl (northern).  This document provided locations of records of potential Northern Hopping-mouse spoils.



### **3.1.3 Aerial Photograph Interpretation**

The most recent available aerial photography of the project site and immediate surrounds (flown by GEMCO in July 2013, September 2013 and March 2014) was utilised for this assessment. Review of aerial photography was utilised for both the flora and the fauna surveys within the project site, as well as supporting the identification of appropriate survey locations. Delineation of vegetation community boundaries incorporated results of aerial photograph interpretation and ground-truthing surveys. Aerial photograph interpretation was also utilised to characterise broad terrestrial fauna habitats.

### **3.1.4 Vegetation Mapping**

The Northern Territory government recognises primary vegetation mapping datasets for different regional areas within the Northern Territory. *Flora and Fauna Surveys on the Western Side of Groote Eylandt, N.T. (1991-92)* (Webb, 1992) is cited as the only primary vegetation mapping dataset for Groote Eylandt (DLRM, 2014c).

The Webb (1992) dataset covers a portion of the western side of Groote Eylandt, primarily the GEMCO mineral leases and includes both the Northern EL and Southern EL. This dataset was produced using stereoscopic examination of colour aerial photographs, field-based ground-truthing and Geographic Information Systems (GIS) software. A review of this mapping was undertaken prior to conducting field surveys within the project site to assist in the refinement of vegetation community mapping.

### **3.1.5 Geological Mapping**

Geological mapping of the project site was sourced from the Northern Territory Department of Mines and Energy (2010) and further verified by GEMCO. This provided an indication of the underlying substrate and was used to inform habitat mapping and the vegetation mapping.

### **3.1.6 Soil Mapping**

Soil mapping of the project site was initially sourced from the National Resource Information Centre (NRIC) Digital Atlas of Australian Soils (Bureau of Rural Sciences, 2014). The EIS Soils Report, which provides a baseline assessment of the soils within the project site at a more detailed scale, was later reviewed as part of this assessment. Soils mapping was utilised to correlate vegetation types and habitat preferences of particular flora and fauna to soil types present within the project site. Soils information was also used to assist in ground-truthing and verifying vegetation communities within the project site.

## **3.2 Overview of Terrestrial Ecology Field Surveys**

### **3.2.1 Overview**

Two rounds of terrestrial ecology field surveys were undertaken in 2014 within the project site. Surveys comprised the following components:



- Flora survey: vegetation mapping and threatened species surveys; and
- Fauna survey: trapping, bird surveys, active searches, bat surveys, infra-red (IR) camera surveys, incidental observations, fauna habitat assessments.

A detailed description of the flora and fauna survey methods utilised for this assessment is provided in **Section 3.3** and **Section 3.4**, respectively.

The terrestrial ecology field surveys were designed to comply with relevant Northern Territory and Commonwealth guidelines as explained below. Survey design was also informed by studies by URS (2012) and Webb (1992) of the mineral leases located to the west of the project site. These earlier surveys covered the same or similar plant communities or habitat types as expected to occur within the project site.

Due to the size of the project site, flora surveys were conducted at strategic locations, including within the proposed infrastructure and disturbance areas, with the results extrapolated by analysis of high resolution aerial photography, geological maps, topographic maps and maps of groundwater depth provided within the EIS Groundwater Report. Fauna field survey locations were carefully chosen so as to provide an adequate level of representative sample areas across the project site and within a range of vegetation communities.

### **3.2.2 Survey Timing**

In order to capture the variation expected in species occurrence and abundance in response to seasonal variations in climate, two rounds of field surveys were undertaken in the project site, in different seasons. Field surveys within the project site were undertaken during the following periods:

- First round: 20 May to 3 June 2014 (early dry season); and
- Second round: 1 October to 14 October 2014 (late dry season).

In addition, IR cameras were set up during the first round of field surveys, and were left in position, recording until the end of the second survey period. This aspect of the survey methodology provided additional unattended survey data.

The first survey period was undertaken in May/June 2014, immediately following the wet season, when natural resources for flora and fauna were expected to be at their peak due to the abundance of water. May was determined to be the earliest opportunity to access the project site, given that it was inaccessible during the preceding months because of heavy rainfall.

The second survey period occurred toward the end of the dry season in October 2014, when conditions were much drier in comparison to the first survey period. Surface water flows and water availability across the project site was far more limited during the October survey period, which provided opportunities to observe and identify areas that were used as refugia during this time.



In conjunction with groundwater information within the EIS Groundwater Report, the locations of water observed during the October 2014 survey period were used to assist in the identification of Groundwater Dependent Ecosystems (GDEs) within the project site.

### 3.2.3 Meteorology During Survey Periods

For each of the survey periods the meteorological conditions (temperature and rainfall) recorded at the Bureau of Meteorology (BoM) weather station at Groote Eylandt Airport (approximately 7 km from the project site) are presented below in **Table 3.2**. The data from this weather station is considered to be broadly representative of the conditions in the project site.

The weather conditions during the May 2014 survey period were characterised by clear, warm days and cool to cold nights. Some small amounts of patchy rainfall occurred during the beginning of the field survey, however for the majority of the period it was dry.

The weather conditions during the October 2014 survey period were characterised by warm to hot days, and cool to moderately warm nights. The entire survey period was dry and whilst no rainfall was recorded at the closest weather station; isolated showers were observed at two of the detailed fauna survey sites on 10 October 2014.

**Table 3.2 Meteorological Conditions Recorded During Field Surveys at the Groote Eylandt Airport BoM Weather Station**

Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rainfall (mm)
<b>First Survey Period</b>			
20/05/2014	20.9	29.6	0.0
21/05/2014	21.5	30.0	2.6
22/05/2014	20.7	31.6	0.0
23/05/2014	21.0	32.2	1.6
24/05/2014	17.7	32.5	0.2
25/05/2014	20.6	32.9	0.0
26/05/2014	19.1	32.2	0.2
27/05/2014	18.6	31.1	0.0
28/05/2014	18.2	32.0	0.0
29/05/2014	19.6	32.1	0.0
30/05/2014	19.1	32.4	0.0
31/05/2014	20.8	32.0	0.0
1/06/2014	21.4	31.2	0.0
2/06/2014	23.3	30.1	0.6
3/06/2014	21.0	29.8	0.0
<b>Average</b>	20.2	31.4	
<b>Total</b>			5.2
<b>Second Survey Period</b>			

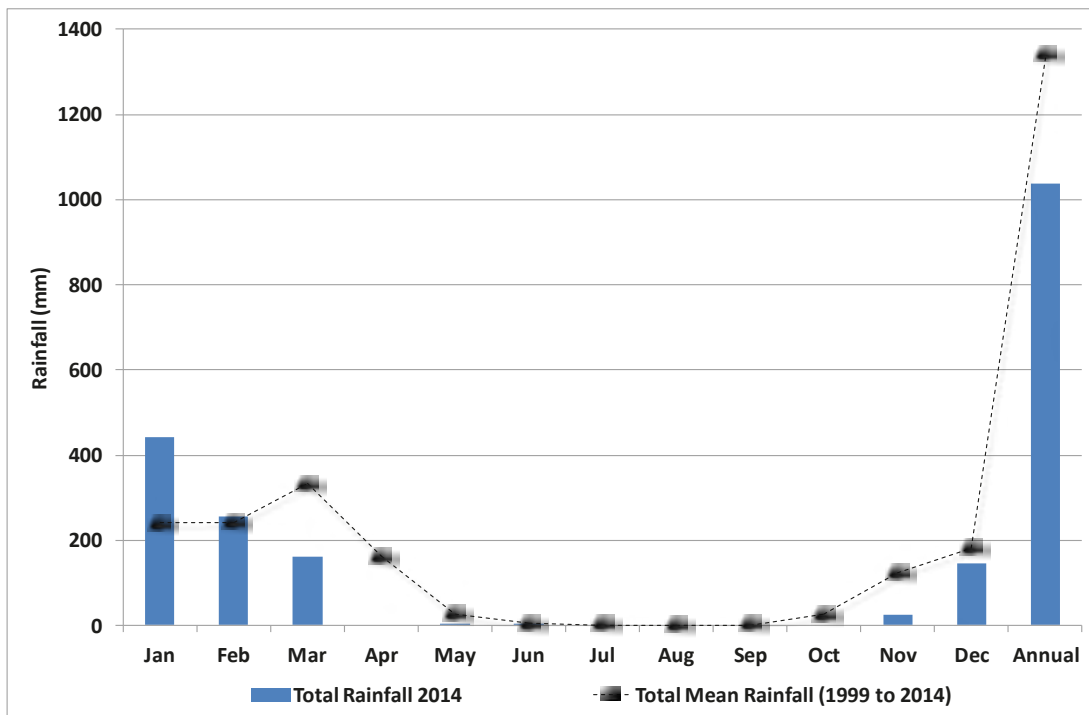




Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rainfall (mm)
1/10/2014	17.6	35.6	0.0
2/10/2014	17.1	32.5	0.0
3/10/2014	16.3	32.9	0.0
4/10/2014	17.8	33.1	0.0
5/10/2014	17.6	32.2	0.0
6/10/2014	19.1	33.7	0.0
7/10/2014	18.1	34.2	0.0
8/10/2014	20.0	32.9	0.0
9/10/2014	19.7	33.5	0.0
10/10/2014	20.7	35.7	0.0
11/10/2014	20.2	34.5	0.0
12/10/2014	20.8	35.0	0.0
13/10/2014	21.2	36.2	0.0
14/10/2014	22.8	33.0	0.0
Average	19.2	33.9	
Total			0.0

*Data obtained from the Groote Eylandt Airport (Station 014518) (BOM, 2014)*

**Graph 1** shows the monthly rainfall in 2014 compared to the historic mean monthly rainfall recorded at the BoM Groote Eylandt Weather Station. As can be seen from **Graph 1**, rainfall in January 2014 was higher than the historic average, however subsequent months in 2014 experienced lower or on average rainfall. In May 2014, the project site retained significant amounts of water, with some areas inaccessible due to the wet conditions. Dry season conditions were experienced in October 2014.



**Graph 1 Comparison of the Historic Average Rainfall to the Rainfall Recorded in 2014 at the Groote Eylandt Airport BoM Weather Station**

### 3.2.4 Project Team

The terrestrial ecology field surveys were undertaken by two teams of two ecologists during each survey period, with each team focussing on either terrestrial flora or fauna ecology. The project team included the following personnel:

- Flora surveys:
  - Dr David Robertson (Cumberland Ecology) – May/June 2014 and October 2014;
  - Jon Schatz (CSIRO – Ecosystem Sciences) – May/June 2014;
  - Cecilia Phu (Cumberland Ecology) – October 2014;
- Fauna surveys:
  - Aleksei Atkin (Cumberland Ecology) – May/June 2014 and October 2014;
  - Dr Alexander Pursche (Cumberland Ecology) – May/June 2014; and
  - Katrina Wolf (Cumberland Ecology) – October 2014.

*Curriculum vitae* of the project team are contained within **Appendix A**.



The project team has relevant prior experience working in northern Australia, including Groote Eylandt. Jon Schatz is based in Darwin with the CSIRO and has worked extensively across the Northern Territory, including Groote Eylandt, Tiwi Islands and Gove. Dr David Robertson and the other members of the project team have worked in Cape York, and are currently engaged to undertake annual fauna and flora monitoring of the rehabilitated areas of the existing GEMCO mine on Groote Eylandt.

Personnel from Cumberland Ecology worked with the assistance of ALC Rangers throughout the October survey period. ALC Rangers assisted during both flora and fauna surveys, including vegetation mapping, establishment of fauna survey sites and diurnal bird surveys.

### **3.3 Flora Assessment Methodology**

#### ***3.3.1 Vegetation Mapping***

Vegetation mapping was undertaken in three stages:

1. Development of a preliminary vegetation map based on a desktop review of available datasets and studies, using aerial photograph interpretation techniques and GIS software (MapInfo Professional 12.5);
2. Collection of detailed site data during field surveys to validate the preliminary mapping and to inform final mapping outputs; and
3. Review and refinement of the preliminary vegetation map based on field datasets.

Each of these stages are discussed in detail below.

##### *i. Development of Preliminary Mapping*

A preliminary base vegetation map was developed prior to the commencement of any related field work. Vegetation boundaries, or “polygons”, were identified based on the high resolution aerial photography supplied by GEMCO.

Existing mapping and vegetation community descriptions for the western portion of Groote Eylandt as detailed in the URS (2012) and Webb (1992) reports were reviewed in order to gain an understanding of the vegetation landscape of the project site. This information, in combination with the interrogation of contour, depth to water table, hydrological and geological datasets, was used to assist in the delineation of vegetation boundaries and to broadly assign vegetation types.

##### *ii. Field Survey*

The purpose of the field surveys was to collect detailed site specific data to inform subsequent adjustments to the preliminary vegetation map.

Field surveys were conducted in accordance with the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst *et al.*, 2007). A total of 33



full characterisation sites (20 x 20 m sample plot areas) were assessed (also referred to in this report as “primary plots”) across the project site in the first survey period. A further 23 check sites (also referred to in this report as “secondary plots”) were surveyed in the second survey period. A cumulative total of 544 meander transect points and track notes were collected across both survey periods. Data collected at each of these plots and points are outlined below. The locations of the flora survey sites are shown in **Figure 5**.

#### a. Primary Plots

Primary sample plots were surveyed in representative areas of the project site. A total of 33 primary plots were surveyed as part of this assessment. The data collected from primary sample plots were used to fully describe the vegetation communities mapped in the project site. Primary plots provide detailed datasets and are critical to the initial stages of a survey where a greater degree of certainty in differentiating vegetation communities is required in order to refine vegetation polygons from broad categorisations to more comprehensive units.

Within primary plots, the following information was collected:

- Plot photographs;
- Coordinate data and survey dates;
- Presence of all vascular plant species;
- Heights and percentage foliage cover of all strata (U = upper, M = midstorey, G = groundstorey);
- Basal area counts;
- Composition of ground cover (percentage bare ground, litter, vegetation, exposed rock and gravel);
- Distribution of species and communities in the project site; and
- Other habitat notes as deemed relevant to the study.

The primary data from the first survey period was used to refine the preliminary vegetation mapping. The resultant draft vegetation mapping was then verified and adjusted after collecting further data during the second survey period.

#### b. Secondary Plots

Secondary plots are less detailed than primary plots and were surveyed to provide adequate data to verify the draft vegetation mapping. A total of 23 secondary plots were surveyed as part of this assessment. Field results from the first survey period identified seasonally wet areas and creek lines as areas requiring particular focus during the second survey period. For this reason, the majority of the secondary plots were located in representative riparian and seasonally wet areas across the project site.



Secondary plot data collected included:

- Plot photographs;
- Coordinate data and survey dates;
- Heights and percentage foliage cover of the dominant species from all strata (U = upper, M = midstorey, G = groundstorey);
- Basal area counts for dominant canopy species;
- Distribution of species and communities in the project site; and
- Other habitat notes as required.

c. Meander Transect Points and Track Notes

Meander transect points and track notes were collected and used to map and verify plant communities across the project site through the collection of summary flora data at point locations across the site.

At each point, two or three dominant plant species were recorded, and details of the cover and height estimates for the dominant strata were noted. Where relevant, notes were also made about outcropping geology, topography, drainage patterns and site disturbance. The point locations were recorded using a hand-held Global Positioning System (GPS) unit, with accuracy to 10 m.

Track notes were made at points of obvious vegetation change, to record transitions between vegetation communities and hence to inform the mapping of vegetation community extents and distributions. To increase the accuracy of the vegetation mapping, track notes were also recorded at regular intervals along the majority of tracks and trails within the project site. Where driving was not possible due to access limitations, areas were walked and similar notes taken at regular points along walked tracks.

Since this information is collected very quickly along either a walked or driven meander transect, vegetation relationships with key landscape features such as creek lines, subtle disturbance effects, or transitional changes between communities can be identified and large areas can be covered.

iii. *Refinement of the preliminary vegetation map based on field datasets*

The preliminary base vegetation map was reviewed after the completion of field surveys. Vegetation polygons were adjusted based on meander and track notes, and plot data.

### **3.3.2 Vegetation Classification and Community Descriptions**

Vegetation communities were classified in accordance with the vegetation communities described in Webb (1992). Webb classified the vegetation communities he studied on Groote Eylandt into 28 “Map Units” (MUs). These MUs were based on the floristic and



structural characteristics of the dominant vegetation type within each community. The nomenclature assigned to each vegetation community for this assessment is consistent with vegetation names identified in Webb (1992). MUs that were not previously described by Webb (1992) were classified in accordance with the National Vegetation Information Systems (NVIS) framework.

The NVIS framework utilises the following classification system which includes a hierarchal level, description and structural/floristic components required for classification:

- Level I – Class: Dominant growth form for the ecologically or structurally dominant stratum;
- Level II – Structural Formation: Dominant growth form, cover and height for the ecologically or structurally dominant stratum;
- Level III – Broad Floristic Formation: Dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum;
- Level IV – Sub-formation: Dominant growth form, cover, height and dominant genus for each of the three traditional strata. (i.e. Upper, Mid and Ground);
- Level V – Association: Dominant growth form, height, cover and species (3 species) for the three traditional strata. (i.e. Upper, Mid and Ground); and
- Level VI – Sub-association: Dominant growth form, height, cover and species (5 species) for all layers/sub-strata.

Vegetation units within the project site were classified to at least Level III in accordance with the NVIS framework.

### **3.3.3 Significant Vegetation Types**

The EIS TOR (NT EPA, 2014) includes a requirement to identify potentially significant vegetation types (also referred to as sensitive vegetation types). Five vegetation communities in the Northern Territory are recognised as sensitive communities and have been described in the *Northern Territory Integrated Natural Resource Management Plan 2010-2015* (Territory Natural Resource Management, 2011) and the *Land Clearing Guidelines* (NRETAS, 2010) as being in need of consideration for protection by the Northern Territory Government. These are:

- Mangrove Forest;
- Monsoon Rainforest and Vine Thickets;
- Old-Growth Forest (containing large trees with significant hollows for fauna);
- Riparian Vegetation; and



➤ Sand-sheet Heath.

The occurrences of any significant vegetation types were mapped in detail using high resolution aerial photography and ground-truthed using meander transect point and track notes as described above. The resultant information was used to inform impact assessment.

### **3.3.4 Threatened Flora Species Searches**

In addition to considerations about sensitive vegetation communities, an analysis was made to determine whether or not threatened plant species could occur in or around the project site. Based on the results of database searches and the detailed literature review, there were no threatened flora species considered to have the potential to occur within the project site.

All vascular flora species found were collected and identified to species level with the exception of some grasses (for which insufficient flowering material was available to be able to identify them to species). The conservation status of all collected specimens was checked to determine whether they were listed as a threatened species.

A collection of plant specimens was made to record all plant species found within primary and secondary plots, at meander points and as incidental specimens when any new plants were observed. The plant specimens were used to compile a herbarium that will be shared by GEMCO and the ALC to support future vegetation surveys and species identification.

### **3.3.5 Survey Effort**

There are no definitive prescriptions in the Northern Territory for sampling intensity for floristic surveys. Guidance on sampling intensity as provided by Brocklehurst *et al.* (2007) and Neldner *et al.* (2012) refer to soil sampling protocols published in the *Australian Soil and Land Survey Guidelines for Conducting Surveys* (Gunn *et al.*, 1988) but acknowledge that sampling densities for vegetation sampling can be much lower since large amounts of mapping data can be collected rapidly as informal observations and track notes. Generally, sampling effort is considered to be adequate when few new species are being identified in a vegetation community across the survey area.

All major vegetation communities within the project site were surveyed and sampling locations were spread across the project site to ensure that adequate coverage was obtained. The cumulative number of new species collected was observed to level off following the completion of field surveys, indicating that there was an adequate survey effort achieved to characterise vegetation community types and to validate the vegetation mapping. Thus, it is considered that the sampling effort for flora surveys is adequate.

Flora survey methods and survey effort are summarised in **Table 3.3**. As indicated in **Appendix C**, the field survey methodology was compliant with relevant guidelines.



**Table 3.3 Flora Survey Effort**

Survey Task	Dates	Survey Effort
Primary Plots	20 May - 3 June 2014	33 (20 m x 20 m) plots
Secondary Plots	20 May - 3 June 2014; 5-14 October 2014	23 plots
Meander Transect Points and Track Notes	20 May - 3 June 2014; 5-14 October 2014	544 data points and throughout survey period
Threatened Flora Searches	20 May - 3 June 2014; 5-14 October 2014	Throughout survey period

### 3.4 Fauna Assessment Methodology

#### 3.4.1 Field Survey

Fauna surveys were conducted by Cumberland Ecology across the project site over two survey periods in order to capture the variation in faunal assemblages attributable to seasonality. The first round of survey was undertaken between 20 May and 3 June 2014 and the second round of surveys was undertaken between 1 October and 14 October 2014. Each of the survey methods utilised for this assessment are detailed below. **Figure 6** shows the locations of fauna survey sites.

Fauna surveys were conducted in accordance with the *Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey* (Northern Territory Fauna Survey Guidelines) (NRETAS, 2011) and included terrestrial trapping (Elliott and cage trapping), pitfall and funnel trapping, bird censuses, active searches, ultrasonic bat call detection, harp trapping, spotlighting, call playback, infra-red camera (IR camera) detection and incidental observations.

The following levels of survey are recognised within the Northern Territory Fauna Survey Guidelines:

- Level 1 Survey: Background research or 'desktop' study and reconnaissance survey; and
- Level 2 Survey: Incorporates Level 1 surveys and detailed survey.

The fauna surveys undertaken for this assessment are equivalent to a Level 2 Survey.

A total of 18 fauna survey sites were established within the project site. **Figure 6** shows the location of the fauna survey sites, and these are fully described and discussed in **Chapter 6**. Nine sites were surveyed in each of the May/June 2014 and October 2014 survey periods.

Survey methods at each fauna survey site included the use of standardised quadrats, including trapping (Elliott, cage, pitfall and funnel), active searches undertaken within a 50 x





50 m quadrat, and bird census and spotlighting within a 100 x 100 m quadrat centred on the trapping quadrat. Song meters (SM2+ units with ultrasonic microphones set to record at a 384Khz sampling rate) were also utilised within each quadrat for the purposes of ultrasonic bat detection. Quadrats were positioned within areas of relatively homogeneous vegetation and landform, and their location recorded using a hand-held GPS unit.

In addition to the standard fauna survey techniques utilised within the standardised quadrats, additional surveys were also undertaken within other areas of the project site. This included the use of IR cameras at both short-term and long-term locations, and harp trapping. The IR cameras were utilised specifically to target trap-shy terrestrial threatened fauna species, but they also provided a secondary benefit of assisting in the collection of general census information on other incidental species.

A separate study of the fauna within mine rehabilitation areas of the existing GEMCO mine was also undertaken in October 2014 and the methodologies and results are presented in a separate report within **Appendix B**.

The methodologies outlined in the subsequent sections therefore only relate to fauna studies undertaken within the project site.

### **3.4.2 Trapping**

A total of 18 fauna sites were sampled using trapping techniques within a 50 x 50 m quadrat. The following traps were established within each quadrat:

- 20 Elliott traps along the perimeter with five located per side;
- Four cage traps, with one located on each corner;
- Four 20 L pitfall buckets and associated drift fence; and
- Four funnel traps set in pairs along drift fence.

Elliott traps were utilised to capture small to medium sized mammals including the Common Rock-rat (*Zyomys argurus*), Grassland Melomys (*Melomys burtoni*) and Northern Quoll (*Dasyurus hallucatus*), whilst the cage traps were utilised to capture medium-large sized mammals including the Northern Brown Bandicoot (*Isodon macrourus*) as well as monitors (*Varanus sp.*). Pitfall traps and funnel traps were utilised to capture reptiles and frogs.

The locations of the trapping sites were recorded using a hand-held GPS unit and the sites marked with flagging tape so they could be easily located. Elliott traps were baited with a mixture of oats, peanut butter, honey, sesame oil, vanilla essence and sardines. Cage traps were baited with the same oat-based bait as well as with meat scraps, such as chicken. The traps were set for three nights, in accordance with the minimum requirements of the Northern Territory Fauna Survey Guidelines. Traps were checked daily, both in the morning and at midday, and any fauna captured were identified and released near the capture point. Elliott and cage traps were rebaited each day as required.



### **3.4.3 Bird Surveys**

At each fauna survey site, eight diurnal bird counts were carried out within a 100 x 100 m quadrat that centred on the trapping quadrat. The majority of bird counts were undertaken in the early morning, with the remainder spread through the morning or early evening. Bird surveys were typically undertaken over a 5-10 minute period and involved a brief walk through the quadrat and recording of the number of individuals of each species observed or heard. Only birds that were utilising the quadrat at the time of survey were recorded (i.e. birds flying overhead and across the quadrat were not included in the data for that quadrat, but were included in the overall species list as an incidental record).

In addition to the diurnal bird surveys, birds were recorded during two nocturnal visits to each fauna survey site. Nocturnal bird surveys were undertaken using spotlighting techniques for a period of at least 15 minutes each night for two nights. Additionally, call playback was undertaken at each site for the threatened Masked Owl (northern) (*Tyto novaehollandiae kimberli*), which had previously been recorded on Groote Eylandt by URS in 2012 (URS Australia Pty Ltd, 2012). Calls were broadcast through an amplifier for approximately 30 seconds, followed by a period of listening for a reply. This sequence was repeated a minimum of three times during each nocturnal survey night at each location, unless a response from the target species had already been received.

### **3.4.4 Active Searches**

Each 50 x 50 m quadrat was actively searched five times for reptiles, amphibians, mammals, scats and signs, comprising three searches during the day and two searches at night using spotlights. Each search took approximately 15 minutes and involved turning rocks and logs, raking through leaf litter, looking under bark or in rock crevices. The number of individuals of each species observed was recorded. Scats, bones and other signs were recorded where these could confidently be attributed to a species.

### **3.4.5 Bat Surveys**

#### *i. Ultrasonic Call Detection*

Ultrasonic call detection surveys for microchiropteran bats (microbats) were undertaken using song meters (SM2+ units with ultrasonic microphones set to record at a 384Khz sampling rate) at each of the detailed fauna survey sites. Units were positioned in suitable habitats, such as along flyways, and were set to activate before dusk each evening and switch off after dawn. In line with the Northern Territory Fauna Survey Guidelines, data was collected from each site over a period of one to four nights. Ultrasonic calls collected from the units were identified using Milne (2002) through the use of the identification key and by comparing the calls with calls held in the associated reference library.

#### *ii. Harp Trapping*

During the second round of field surveys in October 2014, harp trapping was also utilised to survey microbats. One harp trap was set for two nights at three locations within the project site (**Figure 6**). Microbats were collected from harp traps at dawn and the bat species



subsequently identified. All microbats collected from the harp traps were identified immediately and released at the point of capture.

#### **3.4.6 Infra-red Cameras**

IR cameras (Reconyx units) were set up at numerous locations within the project site (**Figure 6**).

Six long-term IR cameras were installed during the first survey period in May/June 2014, and were set to record until the second survey period in October 2014. These cameras were established to target small, trap shy ground-dwelling fauna such as the Northern Hopping-mouse (*Notomys aquilo*) and Brush-tailed Rabbit-rat (*Conilurus penicillatus*). Techniques recommended by Rebecca Diete (PhD candidate undertaking surveys of the Northern Hopping-mouse) regarding the method for IR camera establishment to optimise detection of the Northern Hopping-mouse (*Notomys aquilo*) were applied. Additional IR cameras were also utilised on a short-term basis at various locations during both survey periods to provide general fauna census information.

The cameras were attached to trees and the long-term cameras were focused upon nearby bait (a mix of oats, peanut butter, sesame oil, and tinned sardines), whereas the short-term cameras were focused on tracks or habitat features. The long-term cameras were regularly rebaited during their period of operation.

The cameras were triggered when nearby fauna movement activated the motion sensor. Cameras were set to record a series of three still images during each trigger. Recorded footage was analysed to identify the detected fauna species.

#### **3.4.7 Incidental Observations**

Any vertebrate fauna species that were able to be positively identified from incidental observations, calls, tracks or signs were recorded and listed in the total species list for the project site. The locations of threatened fauna species incidentally observed during surveys were recorded with a hand-held GPS unit.

#### **3.4.8 Targeted Threatened Species Searches**

Targeted searches for threatened species were incorporated into the survey effort described above, and were conducted in accordance with the relevant threatened species survey guidelines, as detailed in **Appendix C**.

Small threatened mammals, such as the Northern Hopping-mouse (*Notomys aquilo*), Brush-tailed Rabbit-rat (*Conilurus penicillatus*), Pale Field-rat (*Rattus tunneyi*), Northern Quoll (*Dasyurus hallucatus*) and Water Mouse (*Xeromys myoides*) were targeted specifically through extensive Elliott trapping, cage trapping, spotlighting, pitfall trapping and the use of IR cameras. These methods were consistent with the requirements of Northern Territory Fauna Survey Guidelines. Guidelines for the survey of the Northern Quoll are provided within the referral guidelines (SEWPaC, 2011a) for the species and field survey methods used for the Northern Quoll were consistent with these guidelines. The Northern Quoll is



well known to be abundant on Groote Eylandt, as such the intensity of survey prescribed in the guidelines was required. Extensive additional survey effort was completed using cage traps and IR cameras. Northern Quolls were detected across the project site using these techniques.

It is worthy to note, that despite some historic reports (Ward, 2009) concluding that spoil heaps on the ground surface were an indicator of the presence of the Northern Hopping-mouse, recent studies (Diete *et al.*, submitted for publication) have found that other species also create similar spoil heaps (such as the Delicate Mouse [*Pseudomys delicatulus*] which is also present on Groote Eylandt). Therefore spoil heaps were not used as an indicator for the presence of the Northern Hopping-mouse.

The Masked Owl (northern) (*Tyto novaehollandiae kimberli*) was surveyed through the use of habitat assessment, spotlighting and call playback. These survey methods are consistent with those outlined in Ward (2010).

Threatened and migratory birds were surveyed through extensive diurnal bird surveys (as detailed in **Section 3.4.3**) and with the use of IR cameras.

Reptiles such as the Salt-water Crocodile (*Crocodylus porosus*), Yellow-spotted Monitor (*Varanus panoptes*), Mertens' Water Monitor (*Varanus mertensi*) and Plains Death Adder (*Acanthopis hawkei*) were targeted through nocturnal spotlighting, active searches, pitfall, funnel and cage trapping, and IR camera surveys.

Several techniques used were chosen specifically to target Northern Hopping-mouse and Brush-tailed Rabbit-rat. These survey methods were selected as they have been shown to successfully identify the species in previous studies. Survey methods that were deemed suitable for detecting the Northern Hopping-mouse and Brush-tailed Rabbit-rat are Elliot trapping (Brush-tailed Rabbit-rat only); IR Cameras (both species); and spotlighting surveys in vehicle and on foot (both species). Diete (2014) successfully detected the Northern-hopping Mouse with IR Cameras, and Ward (2006) successfully detected Brush-tailed Rabbit-rats using spotlight surveys. Survey methodologies that were deemed not suitable for these species included cage trapping (for both species), and for Northern Hopping-mouse Elliot trapping as they are too small to trigger the treadle.

### **3.4.9 Fauna Habitat Assessment**

Fauna habitat assessments were undertaken at each of the detailed fauna survey sites. The standard forms within the Northern Territory Fauna Survey Guidelines were used to record ecologically meaningful information about the sites. This included assessment of ground, understorey and canopy cover and habitat features such as bush rock and fallen trees. General observations of habitat were also made to assist in the development of habitat mapping for threatened species known or considered likely to occur within the project site.

### **3.4.10 Significant Ecosystems**

The EIS TOR (NT EPA, 2014) includes a requirement to identify potentially significant ecosystems, which include, but are not limited to:



- Riparian vegetation;
- Important habitat corridors;
- Monsoon forests;
- Areas of conservation significance; and
- Geological and other features that may support unique ecosystems (e.g. escarpments, gorges and gullies).

Where present, these features have been documented and incorporated into the assessment of habitat types within the project site. The resultant information was used to inform impact assessment.

#### **3.4.11 Survey Effort**

Fauna survey methods and survey effort are summarised in **Table 3.4**. Surveys were undertaken during the two separate survey periods. The first round was conducted between 20 May and 3 June 2014, and the second round was conducted between 1 October and 14 October 2014. The long-term IR cameras were in operation for a total of 19 weeks.

An assessment of the compliance of fauna surveys with the Northern Territory Fauna Survey Guidelines and the relevant Commonwealth survey guidelines is provided in **Appendix C**. As indicated in **Appendix C**, the field survey methodology was compliant with relevant guidelines as far as was feasible within a time-constrained survey. Where surveys were not compliant with guidelines, alternative supporting survey methods were used (such as long term baited remote cameras), which were considered sufficient to detect the presence of threatened fauna. The data collected is considered adequate to inform a thorough impact assessment. Furthermore, a precautionary approach has been taken whereby species considered to have potential to occur have been assessed as though they are present.

**Table 3.4 Fauna Survey Effort**

Survey Technique	Survey Period		Survey Effort
	May / June 2014	October 2014	
Elliot Trapping	x	x	1,080 trap nights (18 sites)
Cage Trapping	x	x	216 trap nights (18 sites)
Pitfall Trapping	x	x	216 trap nights (18 sites)
Funnel Trapping	x	x	216 trap nights (18 sites)
Bird Census (diurnal)	x	x	144 surveys (8 for each of 18 sites)
Bird Census (nocturnal)	x	x	36 surveys (2 for each of 18 sites)
Active Searches (diurnal)	x	x	54 surveys (3 for each of 18 sites)
Active Searches (nocturnal)	x	x	36 surveys (2 for each of 18 sites)



Survey Technique	Survey Period		Survey Effort
	May / June 2014	October 2014	
Ultrasonic Call Detection	x	x	33 trap nights (18 sites)
Harp Trapping		x	8 trap nights (2 nights for each of 4 sites)
IR Camera Detection (Short-term Cameras)	x	x	94 trap nights (16 sites)
IR Camera Detection (Long-term Cameras)	<i>Cameras in place from May to October 2014</i>		719 trap nights (6 sites)
Incidental Observations	x	x	Throughout survey period
Habitat Assessment	x	x	18 sites

### 3.5 Likelihood of Occurrence Assessment

Database searches were undertaken to identify threatened species that are known or have the potential to occur within the project site. The likelihood of such species occurring within the project site was then assessed based on the results of the field surveys and were classified using the criteria presented in **Table 3.5**. The assessment was based on the species known ranges, number and age of records, and habitat preferences which were evaluated considering site characteristics observed during the field surveys.

**Table 3.5 Criteria to Assess Potential for Threatened Species to Occur within the project site**

Likelihood to Occur	Definition
Present	The species was recorded within the project site during current field surveys and / or during previous surveys within the project site by others.
High	The species was not recorded within the project site during current field surveys or during previous surveys within the project site by others, but is known to occur within the surrounding area. Habitat of a similar and suitable quality is known to exist within the project site and it is deemed likely that the species will occur.
Moderate	The species was not recorded within the project site during current field surveys or during previous surveys within the project site by others, although it is known to occur in the wider region. Habitat was identified for the species within the project site during field surveys; however it is marginal, fragmented and/or small in size, or degraded.
Low	The species was not recorded within the project site during current field surveys or during previous surveys within the project site by others. The species is unlikely to occur due to a lack of habitat within the project site, or extremely poor quality habitat within the project site, or no or very few recent records of the species occurring in the wider region exist.



A conservative, risk-based approach was adopted to determine the need for an assessment of potential impacts, such as a significance assessment for species listed under the EPBC Act. This approach considers both the likelihood of occurrence of the species within the project site and the significance of potential habitat loss or disturbance resulting from the project's impacts. This approach ensures that potential project-related impacts on threatened species, which were recorded within the project site or were considered to have a moderate or high likelihood to occur within the project site, were considered. The criteria for determining if further assessment of potential impacts is required are presented in **Table 3.6**

**Table 3.6 Criteria to Determine if Assessment of Impacts is Required for Species**

Likelihood of Species Being Present	Extent of Habitat Loss		
	Nil habitat loss or disturbance from the project	Limited habitat loss or disturbance from the project	Significant habitat loss or disturbance from the project
Confirmed Present	YES	YES	YES
High	NO	YES	YES
Moderate	NO	NO	YES
Low	NO	NO	NO

For species listed under the EPBC Act, the significance of impacts was assessed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r).

As there is currently no prescribed methodology for the assessment of potential impacts under the TPWC Act, assessments of the potential impacts to species listed under the TPWC Act were undertaken on the basis of the species' known ecology, the project design and potential mitigation measures.

### 3.6 Fauna Habitat Modelling on Groote Eylandt

Broad land cover types across Groote Eylandt have been modelled and mapped using satellite imagery by Crase and Hempel (2005). The map provides a good basis for modelling the faunal habitats of Groote Eylandt and it has been modified and upgraded for this assessment in order to provide more detailed information about open forest, woodland, wetland and other habitats.

An updated habitat map of Groote Eylandt was prepared as part of this assessment. It was developed by comparing the broad land cover types mapped using satellite imagery, to both the discernible habitats within recent colour satellite imagery available on Google Earth, and to field survey data. The resultant map clearly delineates the major types of habitats on the



island that are of relevance to the threatened fauna species known to occur. As such, the areas of each habitat type for the island that were calculated using the map, provide a good indication of the context of the proposed development and the relative scale of impact on each habitat.

### 3.7 Limitations of Terrestrial Ecology Field Surveys and Habitat Modelling

No significant limitations to field surveys and habitat modelling were identified. As noted above, this assessment does not solely rely on the information collected during the field surveys of the project site, but also incorporates the relevant findings of numerous surveys conducted over several years and all seasons in nearby areas with the same or very similar habitats. Moreover, the data collected for the project site provides a high degree of confidence in the mapping of vegetation communities and broad fauna habitats – all of which occur on and have been studied extensively for other adjacent and nearby areas. The resultant data collected for this assessment is considered adequate for the purposes of an ecological impact assessment undertaken as part of an EIS process, and meets the EIS TOR (NT EPA, 2014).

#### 3.7.1 Flora

Flora surveys of the project site were conducted across all discernible plant communities and entailed replication spatially and temporally (across two seasons). The vegetation communities sampled, and the species of plants within them, are all found within the adjacent western leases that have been examined in detail by URS (2012) and Webb (1992).

The weather conditions at the time of the flora surveys were generally favourable for plant growth and production of features required for identification of species. However, given the size of the project site, not all flora species present would have been recorded during the current survey. Despite this, it is considered that sufficient information has been collected to assess issues including conservation significance of the flora, condition and viability of vegetation likely impacts.

The plant communities and plant species that occur in the project site are also known to occur in current mining areas immediately to the west of the project site and have been subject to a range of studies for many years, including rehabilitation monitoring studies (URS Australia Pty Ltd, 2010; URS Australia Pty Ltd, 2011) The ecology of these species and communities is generally well known.

The flora surveys conducted within the project site utilised survey techniques outlined within the Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping (Brocklehurst *et al.*, 2007) and relevant EPBC Act survey guidelines (see **Appendix C**).





### **3.7.2 Fauna**

Fauna surveys were successful in detecting a wide range of vertebrate fauna, particularly birds, bats and non-flying mammals. The survey sites were situated in areas where a number of representative habitat types co-occur and therefore are areas of high species diversity.

Data obtained from the fauna surveys are a “snapshot” in time and illustrate the fauna that were active during the time of the surveys. The data produced by the surveys is intended to be indicative of the types of species that could occur and are not an absolute census of all vertebrate fauna species occurring within the project site. It is likely that if continued field sampling was undertaken within the project site, additional species may be identified. For this reason, this assessment has taken into account the results of previous surveys undertaken within, or in close proximity to the project site.

As well as providing an overall census of the vertebrate fauna recorded within the project site, the survey also targeted threatened species predicted to occur. The targeted threatened species surveys generally utilised survey techniques outlined within the Northern Territory Fauna Survey Guidelines and relevant DotE survey guidelines (see **Appendix C**). A precautionary approach was used to assume the presence of some threatened fauna species where suitable habitat was recorded.

### **3.7.3 Habitat Modelling**

The threatened species for which habitat was modelled have broad habitat requirements. Some of the threatened and migratory vertebrates, such as the Northern Quoll (*Dasyurus hallucatus*) occur within all terrestrial habitats on the island. Others such as Mertens’ Water Monitor (*Varanus mertensi*) are much more specific in their preference for habitats, and are known to forage along streams and in riparian vegetation.

The island-wide habitat modelling of broad habitat types is considered adequate to provide a context for the impacts of the proposed project and to indicate what proportion of favoured habitats are to be cleared or impacted for each threatened or migratory species. The resultant habitat modelling data is considered suitable and reliable for the purposes of environmental impact assessment.

## Results: Overview and Desktop Results

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This chapter provides an overview of the environmental values of the project site and surrounds, including information on landform, geology, soils, land zones, hydrology and vegetation. The results of the desktop assessment of threatened and migratory species records are also presented in this chapter.

### 4.1 Overview of Environmental Values

#### 4.1.1 Geology

Groote Eylandt was formed on a stable basement of Proterozoic quartzite. This basement quartzite forms extensive elevated outcrops in the centre of the island.

A blanket of Cretaceous marine sediments was subsequently deposited over the paleosurface of basement and reworked basement materials in the west of the island. The distribution of the Cretaceous marine sediments is generally confined to the western plains and valleys of the island. The upper Cretaceous sediments contain the manganese ore.

The manganese ore is a sedimentary layer, consisting of manganese strata occurring between clay and sand beds.

Much of the Cretaceous sediment profile (including some of the manganese ore) has been extensively modified by a long period of tropical weathering (or laterisation) during the Tertiary period. This has resulted in the development of thick laterite profiles up to 25 m thick.

The surface geology of the project site comprises lateritic deposits between outcropping (i.e. exposed) quartzite (**Figure 7**). Localised areas of sand are also present at the site.

The surface geology of the project site strongly influences vegetation composition across the site, as the geological surface erodes to provide sandy, relatively infertile soils, typically suitable only for native vegetation types, such as Eucalypts, Melaleucas and Cypress.

#### 4.1.2 Soils

Six soil mapping units have been identified as occurring within the project site (refer to the EIS Soils Report). Soils mapping for the project site is shown in **Figure 8**, and **Table 4.1** provides a summary of the soil map units occurring within the project site. The soil mapping indicates that the project site is dominated by areas of deep brown to light grey brown sandy



earths, loams and gradational contrast soils (units B1, B1v, B2), with minor areas of clay loam subsoils relating to active drainage pathways (unit A1), rugged upland areas with very shallow soils and dense rocky outcrops (unit Q1). An isolated area of densely vegetated monsoonal vine thicket (unit V1) is known to occur in the Southern EL on a very dense rocky undulating plain.

**Table 4.1 Soil Units Recorded within the Project Site**

Unit	Soils	Vegetation	Occurrence
A1	Alluvial floodplains and gully areas in level to gently undulating plains	Mid high open woodland of Broad-leaved Paperbarks ( <i>Melaleuca viridiflora</i> ) and Long-fruited Bloodwood ( <i>E. polycarpa</i> )	Associated with active drainage pathways.
B1	Dark brown to reddish brown loamy sands on undulating plains	Tall open woodland of Stringybarks ( <i>Eucalyptus tetradonta</i> ) with	Predominant across the project site and typically occurs along the boundaries and footslopes of the surrounding rugged upland areas.
B1v	Light brownish grey to yellow brown loamy sands on undulating plains	Darwin Woollybutt ( <i>E. miniata</i> ), Cypress Pine <i>Callitris intratropica</i> and Long-fruited Bloodwood ( <i>E. polycarpa</i> ).	Localised area in the north eastern part of the Northern EL.
B2	Brownish black loamy sands on level to undulating plains	Tall sparse shrubland to low open woodland of Stringybarks ( <i>E. tetradonta</i> )	Adjacent to unit B1, in areas of level and gently undulating plains.
Q1	Rugged uplands on quartz sandstone with minor Leptic Rudosols	Mid high to tall open woodland of Stringybarks ( <i>E. tetradonta</i> ) and <i>E. ferruginea</i>	Typically in areas toward the boundary of the Eastern Leases with one large expanse located within the centre of the Southern EL.
V1	Very dense rocky undulating plain with dense vegetation	Monsoonal vine thicket	A densely vegetated monsoonal vine thicket situated to the south of the Southern EL.



### 4.1.3 Land Systems

The project site is characterised by low relief, with low hills of outcropping of quartzitic rock bordering flat to undulating sand plains that have some areas of outcropping conglomerate. Areas of sandstone rocky outcrops occur along the eastern and southern boundaries of the Northern EL, fringing the south western border of the Southern EL, the central eastern portion of the Southern EL and along portions of the haul road corridor.

Land systems within the Northern Territory have been mapped and described by NT DLRM (Lynch and Wilson, 1998; Lynch *et al.*, 2012). Five land systems are recognised in the project site and locality (**Figure 9**) and these are shown in **Table 4.2**. The land systems support different types of vegetation, and provide important habitat for a broad range of plant and animal species.

**Table 4.2 Land Systems within the Project Site (after Lynch, 1998)**

Landform (Lynch, 1998)	Indicated Soil Types (Northcote et al, 1960-1968)	Vegetation (Lynch, 1998)
Level to gently undulating plains Land System: Yarrowirrie (Yrw)	Red earths Kandosols and Orthic Tenosols	Tall sparse shrubland to low open woodland of <i>Eucalyptus tetradonta</i>
Rugged dissected plateaux on quartz sandstone Land System: Groote (Grt)	Bare rock and Leptic Rudosols	Mid high to tall open woodland of <i>E. tetradonta</i> and <i>E. ferruginea</i>
Sandy colluvial footslopes below elevated quartz sandstone plateaux Land System: Bundah (Bnd)	Leptic and Orthic Tenosols	Tall open woodland of <i>E. tetradonta</i> with <i>E. miniata</i> , <i>Callitris intratropica</i> and <i>E. polycarpa</i>
Level to gently undulating alluvial floodplains Land System: Effington (Efg)	Kandosolic, Tenosolic and Chromosolic Redoxic Hydrosols	Mid high open woodland of <i>Melaleuca viridiflora</i> and <i>E. polycarpa</i>
Gently undulating sandy plains Land System: Queue (Que)	Orthic Tenosols	Tussock grass open woodland consisting of <i>E. tetradonta</i> , <i>E. miniata</i> and <i>Corymbia ferruginea</i> (also known as <i>Eucalyptus ferruginea</i> ) trees with <i>Acacia mimulain</i> the mid-storey

### 4.1.4 Hydrology and Hydrogeology

The project site is located in the upper catchments of the Emerald, Amagula and Angurugu Rivers. The Emerald River and its tributaries drain the majority of the Northern EL and the western area of the Southern EL (**Figure 10**). The Amagula River drains the eastern area of the Southern EL via two main tributaries. The north-eastern area of the Northern EL is within the catchment of the Angurugu River.



Shallow groundwater underlies much of the project site and strongly influences vegetation species composition and structure. The EIS Groundwater Report contains further information regarding the quality, recharge and directional flow paths of groundwater across the project site.

#### **4.1.5 Vegetation**

The vegetation across the entire project site comprises remnant vegetation, and there has been no clearing of vegetation. Overall the vegetation is in very good condition and it is characterised by a high species and structural diversity, although the structure of the understorey and the condition of the ground layer has been modified by a very frequent fire regime. Few weeds have been recorded within the project site.

Due to the remnant vegetation status of the entire project site, and the lack of vegetation clearance undertaken to date, habitat connectivity in the landscape is excellent and unbroken throughout the project site. The project site provides linkages with remnant vegetation on all sides that can be utilised by fauna species to connect to adjacent areas of habitat. The project site provides a range of habitats for fauna species, including watercourses and wetlands, rocky outcrops and extensive areas of woodland.

The project site is regularly burnt by the traditional owners, which has resulted in a reduction in the amount of woody debris, and is also likely to have affected the species composition and structure of the vegetation. Some species are highly sensitive to changes in fire regime, and it is likely that this may have influenced the suite of species that currently utilise the project site.

#### **4.1.6 Fauna Habitats**

A range of broad fauna habitats occurs on Groote Eylandt, as shown in **Figure 11**. These include:

- Closed Forest - rainforest and monsoon vine thickets with a closed canopy. These occur in areas protected from fires;
- Open Forest - open forest with a layered shrub and grass understorey. The most common forms are dominated by *Eucalyptus tetradonta* and *E. miniata* on deeper sandy soils;
- Sandstone Woodland - sparse woodland to low open woodland occurring on sandstone ranges with skeletal soil and extensive rock outcrops;
- Coastal Complex/Dunes - various coastal dune shrubland, woodland and exposed sand dune areas. These comprise deep aeolian sand deposits;
- Riparian Zone - various stream bank habitats including *Melaleuca* woodlands, some areas with rainforest elements and eventually areas of mangroves;
- Active Mining and Recent Rehabilitation - the western leases of GEMCO; and



- Lakes - coastal lakes and lagoons, principally on the east of the island.

The areas of each of these habitat categories are shown in **Table 4.3**. As can be seen from the table, mining areas and rehabilitation areas account for 1.4% of the island's land surface area. The majority of the island (more than 95%) comprises relatively pristine habitats.

**Table 4.3 Broad Categories and Areas of Habitats on Groote Eylandt**

Broad Habitat Types	Groote Eylandt (ha) <sup>1</sup>	% of Total Area
Closed Forest	6,145.3	2.7
Open Forest	118,071.2	51.1
Sandstone Woodland	55,195.9	23.9
Coastal Complex/Dunes	41,959.5	18.2
Riparian Zone	4,180.8	1.8
Active Mining and Recent Rehabilitation	3,310.1	1.4
Lakes	2,317.3	1.0
<b>TOTAL</b>	<b>231,180</b>	<b>100</b>

<sup>1</sup> Based on interpolation of aerial photography

#### 4.1.7 Land Uses

The land within and surrounding the project site comprises natural bushland. No farming or agriculture activities are undertaken in the vicinity of the project site, however the vegetation is regularly burnt. The primary activities undertaken currently within the project site, other than activities undertaken by the Traditional Owners, are related to exploration drilling, requiring minor clearance of vegetation for tracks and drill pads.

## 4.2 Database Results

An analysis of ecological databases was conducted for the project site and its surrounds, including interrogation of the DotE EPBC PMST (DotE, 2014b) and InfoNet database (DLRM, 2014d). The results of these database searches are presented in **Appendix D** and **Appendix E**, respectively, and summarised below.

### 4.2.1 Vegetation Communities

The EPBC Act PMST did not record any Threatened Ecological Communities (TECs) as occurring or potentially occurring within a 20 km radius of the project site.

The TPWC Act contains no listings for threatened ecological communities, as such no records are held within the InfoNet database.



### 4.2.2 Flora Species

The EPBC Act PMST report generated for the project site indicates that no flora species listed under the EPBC Act or threatened flora species habitat are known, or considered likely to occur within a 20 km radius of the project site.

The InfoNet database holds records for one threatened flora species on Groote Eylandt, namely *Hernandia nymphaeifolia* (Lantern Tree) which is listed as Vulnerable under the TPWC Act. Records of threatened flora species on Groote Eylandt from the InfoNet database are shown on **Figure 12**. This species was last recorded in 1988, on the eastern coast of Groote Eylandt. It is not considered likely to occur within the project site as it is only known to occur in littoral rainforest and coastal swamps, and neither vegetation type is found in the project site.

### 4.2.3 Fauna Species

Results of the database searches for threatened fauna species listed under the EPBC Act and/or the TPWC Act are shown in **Table 4.4** and **Appendix F**. **Table 4.4** also notes the species listed in the EIS TOR for this project.

The EPBC Act PMST results indicate that numerous migratory and/or marine species listed under the EPBC Act have potential to occur in the locality. As the locality (defined in this report as a 20 km radius around the project site) includes some ocean areas, the search yields numerous marine species including fish, turtles and marine mammals. These are not relevant to an assessment of terrestrial ecology and are not considered in detail in this report.

Records of threatened and migratory fauna species on Groote Eylandt from the InfoNet database are shown on **Figure 13** and **Figure 14**, respectively.

**Table 4.4 Threatened and Migratory Fauna Species Database Records and EIS TOR Requirements**

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Results		TOR Species
		EPBC Act	TPWC Act	PMST	InfoNet <sup>2</sup>	
<b>Birds</b>						
Red Knot	<i>Calidris canutus</i>		V		X	
Curlew Sandpiper	<i>Calidris ferruginea</i>		V		X	
Great Knot	<i>Calidris tenuirostris</i>		V		X	
Greater Sand Plover	<i>Charadrius leschenaultii</i>		V		X	
Lesser Sand Plover	<i>Charadrius mongulus</i>		V		X	
Red Goshawk	<i>Erythrotriorchis radiatus</i>	V		X		X
Gouldian Finch	<i>Erythrura gouldiae</i>	E	V		X	

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Results		TOR Species
		EPBC Act	TPWC Act	PMST	InfoNet <sup>2</sup>	
Partridge Pigeon	<i>Geophaps smithii</i>	V	V		X	
Bar-tailed Godwit	<i>Limosa lapponica</i>		V		X	
Eastern Curlew	<i>Numenius madagascariensis</i>		V		X	
Masked Owl (northern)	<i>Tyto novaehollandiae kimberli</i>	V	V			X
Fork-tailed Swift	<i>Apus pacificus</i>	M(m)		X		
Streaked Shearwater	<i>Calonectris leucomelas</i>	M(m)		X		
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	M(t)		X		X
Barn Swallow	<i>Hirundo rustica</i>	M(t)		X		
Rainbow Bee-eater	<i>Merops ornatus</i>	M(t)		X		X
Rufous Fantail	<i>Rhipidura rufifrons</i>	M(t)		X		
Eastern Great Egret	<i>Ardea modesta</i>	M(w)		X		
Cattle Egret	<i>Ardea ibis</i>	M(w)		X		
Oriental Plover	<i>Charadrius veredus</i>	M(w)		X		
Oriental Pratincole	<i>Glareola maldivarum</i>	M(w)		X		
<b>Mammals</b>						
Brush-tailed Rabbit-rat	<i>Conilurus penicillatus</i>	V	E	X	X	X
Northern Quoll	<i>Dasyurus hallucatus</i>	E	CE	X	X	X
Northern Hopping-mouse	<i>Notomys aquilo</i>	V	V	X	X	X
Pale Field Rat	<i>Rattus tunneyi</i>		V		X	X
Water Mouse	<i>Xeromys myoides</i>	V		X		X
<b>Reptiles</b>						
Plains Death Adder	<i>Acanthopis hawkei</i>	V		X		X
Yellow-spotted Monitor	<i>Varanus panoptes</i>		V		X	X
Mertens' Water Monitor	<i>Varanus mertensi</i>		V		X	X
Salt-water Crocodile	<i>Crocodylus porosus</i>	M(m)		X		
<b>Species Restricted to Marine Environment</b>						
Blue Whale	<i>Balaenoptera musculus</i>	E, M(m)		X		
Humpback Whale	<i>Megaptera novaeangliae</i>	V, M(m)		X		
Killer Whale	<i>Orcinus orca</i>	M(m)		X		
Bryde's Whale	<i>Balaenoptera edeni</i>	M(m)		X		
Dugong	<i>Dugong dugong</i>	M(m)		X		
Loggerhead Turtle	<i>Caretta caretta</i>	E, M(m)		X		





Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Results		TOR Species
		EPBC Act	TPWC Act	PMST	InfoNet <sup>2</sup>	
Green Turtle	<i>Chelonia mydas</i>	V, M(m)		X	X	X
Leatherback Turtle	<i>Dermochelys coriacea</i>	E, M(m)		X		
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	V, M(m)	V	X	X	X
Olive Ridley Turtle	<i>Lepidochelys olivacea</i>	E, M(m)	V	X	X	
Flatback Turtle	<i>Natator depressus</i>	V, M(m)		X	X	X
Giant Manta Ray	<i>Manta birostris</i>	M(m)		X		
Irrawaddy Dolphin	<i>Orcaella brevirostris</i>	M(m)		X		
Indo-Pacific Humpback Dolphin	<i>Sousa chinensis</i>	M(m)		X		
Great White Shark	<i>Carcharodon carcharias</i>	V, M(m)		X		
Dwarf Sawfish	<i>Pristis clavata</i>	V		X		X
Large-tooth Sawfish	<i>Pristis pristis</i>	V				X
Green Sawfish	<i>Pristis zijsron</i>	V		X		X
Whale Shark	<i>Rhincodon typus</i>	V, M(m)		X		

1 Conservation Status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory [(m) = marine, (t) = terrestrial, (w) = wetland]

2 The InfoNet search was for threatened species listed under the TPWC Act. The search does not, therefore, provide records for species listed as Migratory under the EPBC Act, given that those species have no statutory protection in the Northern Territory.

## Results: Flora

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### 5.1 Vegetation Communities

The vegetation community patterns within the project site strongly reflect the geology, soils, topography, and the impacts of frequent fires. Rocky sandstone hills are vegetated by low woodland. Gently undulating, well-drained sand plains are forested. On flatter, low relief areas forests give way to woodlands, swamps and sedgeland. Native pines form thickets in places and are prevalent where the sand plains meet the rocky hillsides. Riparian forest and woodland occur along permanent and seasonal streams. Rainforests and vine thickets occur in areas protected from fires and as such are generally found beside streams and protected rocky sites.

The most extensive vegetation community within the project site comprises open forests dominated by *Eucalyptus tetradonta* (Darwin Stringybark) and *Eucalyptus miniata* (Darwin Woollybutt) that occur on gently undulating sandy soils (**Figure 15**). The next most extensive vegetation community occurs on the rocky sandstone hills and comprises woodland dominated by *Callitris intratropica* (Northern Cypress Pine), *Eucalyptus tetradonta* and *Eucalyptus kombolgiensis* (Scarp Gum). The remainder of the project site is comprised of a mix of low woodlands, swamp and sedgeland vegetation which are typically characterised by species such as *Corymbia polycarpa* (Long-fruited Bloodwood), *Eucalyptus tectifica* (Darwin Box), *Melaleuca viridiflora* (Broad-leaved Paperbark), *Melaleuca cajuputi* (Swamp Tea Tree), *Pandanus spiralis* (Common Screwpine) and *Grevillea pteridifolia* (Darwin Silky Oak).

**Table 5.1** lists the vegetation communities recorded from the project site. Each vegetation community has been classified in accordance with Webb (1992) where possible (see **Section 3.3.1**). The vegetation mapping for the project site is shown in **Figure 15**. Detailed vegetation profiles containing descriptions and photos of each vegetation community are provided in **Appendix G**.

**Table 5.1 Vegetation Communities within the Project Site**

Vegetation Community	Area (ha) <sup>1,2</sup>
<b>MU3</b> - Dry sub-coastal (inland) monsoon vine forest	0.7
<b>MU4</b> - <i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> open forest with low shrub or tussock grass understorey	3,136.8
<b>MU5</b> - <i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> / <i>Callitris intratropica</i> open-forest with mixed shrub/ tussock grass understorey	35.4
<b>MU10a</b> - <i>Melaleuca viridiflora</i> / <i>Corymbia polycarpa</i> open forest with <i>Pandanus spiralis</i> and mixed tussock grassland understorey	143.7
<b>MU10b</b> - <i>Melaleuca viridiflora</i> open-forest and mixed tussock grassland understorey	9.8
<b>MU11</b> - <i>Melaleuca leucadendra</i> / <i>Dillenia alata</i> open forest with fern/ sedge understorey	32.4
<b>MU15a</b> - <i>Melaleuca cajuputi</i> low closed-forest/ <i>Leptocarpus</i> sedgeland/ closed sedgeland (permanent swamps/ sedgelands)	8.8
<b>MU16</b> - <i>Eucalyptus tetradonta</i> low open forest / woodland with low tree or <i>Sorghum interjectum</i> tussock grassland understorey	275.2
<b>MU17</b> - <i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> / <i>Eucalyptus polycarpa</i> woodland with low shrub or tussock / hummock grass understorey	237.8
<b>MU18</b> - <i>Callitris intratropica</i> / <i>Eucalyptus tetradonta</i> / <i>Eucalyptus kombolgiensis</i> woodland to open woodland with hummock grassland understorey	557.5
<b>MU20</b> - <i>Melaleuca viridiflora</i> / <i>Eucalyptus polycarpa</i> / <i>Grevillea pteridifolia</i> woodland with <i>Asteromyrtus symphyocarpa</i> and <i>Vetiveria elongata</i> tussock grassland	53.4
<b>MU24</b> - <i>Eucalyptus tetradonta</i> / <i>Eucalyptus polycarpa</i> / <i>Melaleuca viridiflora</i> low open-woodland with <i>Asteromyrtus symphyocarpa</i> shrubland	25.1
<b>MU31</b> - <i>Eucalyptus tectifica</i> open woodland with mixed shrub/ tussock grass understorey	62.5
Water	2.6
<b>Total (nearest hectare)</b>	<b>4,582</b>

1 In some cases totals may not equal the appropriate total number due to rounding.

2 The area includes Northern EL and Southern EL (comprising 4,414 ha) and the haul road corridor (comprising 168 ha)

### 5.1.1 Threatened Ecological Communities

#### i. Commonwealth Legislation

Only one ecological community that occurs in the Northern Territory is listed as Endangered under the Commonwealth EPBC Act. This is the *Arnhem Plateau Sandstone Shrubland*



*Complex*, however this TEC does not occur on Groote Eylandt. The EPBC Act PMST does not show the presence of any EPBC Act listed TECs on Groote Eylandt.

Considering the above, it is concluded that no threatened ecological communities occur on the project site. Threatened ecological communities are therefore not considered or assessed further in this report.

ii. *Northern Territory Legislation*

There is currently no mechanism for listing threatened ecological communities under Northern Territory legislation (DLRM, 2014e). Therefore, the TPWC Act contains no listings for threatened ecological communities and this is not assessed further in this report.

### **5.1.2 Significant Vegetation Types**

Five broad types of vegetation in the Top End are recognised as significant (also referred to as sensitive) and in need of protection by the Northern Territory Government (Territory Natural Resource Management, 2011). These are listed and described in **Table 5.2**.

Of these broad vegetation communities, no Mangrove Forests or Sand-sheet Heaths occur in the project site. However, some areas of Monsoon Rainforest, Old-Growth Forest, and Riparian Vegetation occur in the project site. The vegetation communities recorded from the project site that are considered to be sensitive communities are:

- Old-Growth Forests:
  - MU4 - *Eucalyptus tetradonta* / *Eucalyptus miniata* open forest with low shrub or tussock grass understorey;
  - MU5 - *Eucalyptus tetradonta* / *Eucalyptus miniata* / *Callitris intratropica* open-forest with mixed shrub/ tussock grass understorey;
- Dry Monsoon Rainforests:
  - MU3 - Dry sub-coastal (inland) monsoon vine forest;
- Riparian Vegetation:
  - MU11 - *Melaleuca leucadendra* / *Dillenia alata* open forest with fern / sedge understorey; and
  - MU20 - *Melaleuca viridiflora* / *Eucalyptus polycarpa* / *Grevillea pteridifolia* woodland with *Asteromyrtus symphyocarpa* and *Veticeria elongata* tussock grassland.

Table 5.2 Sensitive or Significant Vegetation Types Recognised by the Northern Territory Government

Description <sup>1</sup>	Significance <sup>1</sup>	Characteristics <sup>1</sup>	Threats <sup>1</sup>	Occurrence on Project Site
<p><b>Old-Growth Forest</b></p> <p>Typically associated with the tall damp forests of the southern states, featuring massive 400-500 year old trees, where hollow-bearing trees are abundant. Old-growth forest occurs in the tall eucalypt open forests and the tropical savannah of the Territory.</p> <p>Tall eucalypt open forests, typically dominated by <i>Eucalyptus tetradonta</i> (Darwin Stringybark) and <i>Eucalyptus miniata</i> (Darwin Woollybutt), are restricted to the higher rainfall areas of the Top End and typically occur on deep sandy and loam soils.</p>	<p>Tree hollows are considered to be a key resource for a range of animals. Old-growth forests are rich in hollow resources.</p>	<p>A Top End eucalypt forest is considered an old-growth forest if it has either:</p> <ul style="list-style-type: none"> <li>• 5 or more eucalypt stems greater than 50 cm diameter per hectare; and/or</li> <li>• 30 or more eucalypt stems greater than 40 cm diameter per hectare.</li> </ul>	<ul style="list-style-type: none"> <li>• Cyclones</li> <li>• Fires</li> <li>• Feral animals</li> <li>• Horticulture and forestry</li> </ul>	<p>Present on the project site, and represented by MU4 and MU5.</p>
<p><b>Mangrove Forest</b></p> <p>Mangroves are found along sheltered tropical and subtropical coast lines, growing in tidal areas on semi fluid mud and frequently inundated by saline water.</p> <p>A mangrove community may contain a variety of plants, from trees, palms, shrubs, vines, epiphytes, samphires, grasses and ferns. The community can vary from dense closed forests through to sparse shrublands and samphire on salt flats.</p> <p>Mangroves have specialised adaptations enabling them to grow and reproduce under demanding conditions. High levels of salt; tidal inundation and wave action typify these challenging conditions.</p>	<p>Mangroves provide spawning and nursery areas for many marine species and protect the coastline from erosion during storm surges and cyclones.</p> <p>Mangroves support highly specialised animals, including many species which occur nowhere else.</p>	<p>Vegetation dominated by mangrove species and occurring in intertidal zones.</p>	<ul style="list-style-type: none"> <li>• Development in coastal areas</li> <li>• Pollution</li> </ul>	<p>Not present on the project site.</p>
<p><b>Monsoon Rainforest</b></p> <p>Monsoon rainforests are areas of vegetation with a dense tree canopy that occur in regions with a monsoonal wet/dry climate. In the Territory, monsoon rainforests commonly occur in small discrete patches.</p> <p><i>Dry monsoon rainforests</i> (also referred to as monsoon vine thickets) occur on sites where moisture is seasonally scarce. These forests are, typically found on beach dunes and rock</p>	<p>Rainforests are highly restricted vegetation types, but are some of the most bio-diverse communities.</p>	<p><i>Dry monsoon rainforests</i> (or monsoon vine thickets):</p> <ul style="list-style-type: none"> <li>• &gt;70 % foliage cover;</li> <li>• 5-10 m tall; and</li> <li>• Dominated by creeping vines, lianas and</li> </ul>	<ul style="list-style-type: none"> <li>• Land clearing and fragmentation</li> <li>• Fires</li> <li>• Feral animals and introduced ants</li> <li>• Weed invasion</li> </ul>	<p>Dry monsoon rainforest is present on the project site and is represented by MU3.</p> <p>No wet monsoon rainforest is present</p>

Description <sup>1</sup>	Significance <sup>1</sup>	Characteristics <sup>1</sup>	Threats <sup>1</sup>	Occurrence on Project Site
<p>outcrops where extra moisture collects and fires aren't as prevalent.</p> <p><i>Wet monsoon rainforests</i> are typically associated with areas of permanent moisture availability, such as permanent creeks and springs, and are dominated by evergreen trees and palms.</p>		<p>scramblers.</p> <p><i>Wet monsoon rainforests</i>:</p> <ul style="list-style-type: none"> <li>• &gt;70 % foliage cover;</li> <li>• up to 30 m tall;</li> <li>• Dense understorey of smaller trees, ground ferns and sedges; and</li> <li>• Vines are not prominent in this rainforest type.</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture</li> <li>• Impacts on rainforest aquifers</li> <li>• Fertilisers and pesticides</li> </ul>	<p>on the project site.</p>
<p><b>Riparian Vegetation</b></p> <p>Riparian vegetation is a distinct forest community occurring on the banks of rivers or streams that directly influences the adjacent water body.</p>	<p>Shades and moderates temperature fluctuations in streams, creating suitable conditions for breeding in many aquatic species.</p> <p>Protects stream banks from erosion and filter any sediment or nutrients in overland flow before the flow enters the stream, thus reducing sedimentation of aquatic habitats and reducing nutrient induced algal blooms.</p> <p>Has higher moisture and shade levels and more productive organic soils compared to surrounding woodlands and thus supports a distinct suite of plant and animal species.</p> <p>Provides important refuge for woodland species during the dry season.</p> <p>Provides movement corridor for animals.</p> <p>Snags from fallen trees also create valuable fish habitat.</p>	<p>Riparian vegetation is a distinct forest community occurring on the banks of rivers or streams that directly influences the adjacent water body.</p>	<ul style="list-style-type: none"> <li>• Weed invasion</li> <li>• Fires</li> <li>• Feral animals</li> <li>• Over-grazing</li> <li>• Land clearing</li> </ul>	<p>Present on the project site, and represented by MU11 and MU20.</p>



Description <sup>1</sup>	Significance <sup>1</sup>	Characteristics <sup>1</sup>	Threats <sup>1</sup>	Occurrence on Project Site
<p><b>Sand-sheet Heath</b></p> <p>Sand sheets have acidic infertile soils overlaying an impermeable deposit of clay or laterite, and are flooded during the wet season.</p> <p>Heath is the term used to describe the community of plants found on the sand sheet. Sand sheet heath has a mix of species, typically with a diverse understorey of herbs and sedges and an overstorey of small trees or shrubs such as <i>Grevillea pteridifolia</i>, <i>Banksia dentata</i> (Tropical Banksia), <i>Verticordia cunninghamii</i> (Cunningham's Feather Flower) and <i>Melaleuca nervosa</i> (Yellow-barked Paperbark).</p> <p>Sand sheet Heath is also frequently associated with monsoon rainforests, other wetlands and riparian vegetation. These are all restricted vegetation types in the Territory and hotspots for biodiversity.</p>	<p>Sand sheet heath is a rare vegetation type present in the Darwin region, covering 56 km<sup>2</sup>. Although not formally listed as threatened, seasonally saturated sand sheets supporting a heathland or wet herbfield are highly restricted and are identified as an ecosystem at risk within the Darwin region.</p> <p>Supports the highest diversity of Bladderworts, which are adapted to low nutrient environments. Many Bladderwort species are listed as Vulnerable or Near Threatened.</p>	<p>See description.</p>	<ul style="list-style-type: none"> <li>• Land clearing for mineral extraction</li> <li>• Rural agriculture</li> <li>• Hydrological change</li> <li>• Nutrient enrichment</li> <li>• Fires</li> </ul>	<p>Not present on the project site.</p>

1 From factsheet series "Sensitive Vegetation in the Northern Territory" (DLRM, 2014b).



### 5.1.3 Seasonal Wetlands

A number of wetland vegetation types are present within the project site and generally occur in low-lying areas. The wetlands are seasonal, and may be expressed as dry swamp woodlands during the dry season.

The following vegetation communities recorded within the project site have been identified as being seasonal wetlands as they are regularly inundated and are saturated at a frequency that can support wetland plants (such as sedge and fern species) and animals (such as herons and egrets).

- MU10a - *Melaleuca viridiflora* / *Corymbia polycarpa* open forest with *Pandanus spiralis* and mixed tussock grassland understorey;
- MU10b - *Melaleuca viridiflora* open-forest and mixed tussock grassland understorey;
- MU15a - *Melaleuca cajuputi* low closed-forest / *Leptocarpus* sedgeland / closed sedgeland (permanent swamps/ sedgelands); and
- MU24 - *Eucalyptus tetrodonta* / *Eucalyptus polycarpa* / *Melaleuca viridiflora* low open-woodland with *Asteromyrtus symphyocarpa* shrubland.

## 5.2 Flora Species

A total of 249 plant species were recorded within the project site over the two seasons of survey (**Appendix H**). The floristic assemblage was found to be well represented by Poaceae (grasses), Fabaceae – Faboideae (peas), Myrtaceae (*Eucalyptus*, *Angophora* and *Melaleuca*) and Cyperaceae (sedges). *Acacia* and *Eriachne* were the most dominant genera.

### 5.2.1 Threatened Flora Species

#### i. EPBC Act Species

No threatened species listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act have been recorded within the project site, which is consistent with the EPBC Act PMST report generated for the project site.

#### ii. TPWC Act Species

No threatened species listed as Critically Endangered, Endangered or Vulnerable under the TPWC Act have been recorded within the project site, which is consistent with the database records for Groote Eylandt.





Three species listed as Data Deficient species were recorded within the project site. These species are:

- *Stephania japonica* (recorded within MU11 along the Emerald River – Tributary 2);
- *Evolvulus alsinoides* (recorded in MU18 and MU31); and
- *Clerodendrum floribundum* (recorded in MU4, MU10a and MU11).

Data Deficient species are those species that have been evaluated but for which insufficient data exists to determine whether the species should be listed as a threatened species or declared a species of Least Concern (LC).

### 5.2.2 Declared Weeds

No declared weeds were recorded within the project site. Although a number of declared weeds were recorded within GEMCO's existing mining tenement (URS Australia Pty Ltd, 2011; URS Australia Pty Ltd, 2012; Addison, 2013), the project site has been relatively unaffected by anthropogenic activities excepting fire management activities and recent exploration drilling. The vegetation within the project site was therefore relatively unaffected by weeds.

## 5.3 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems are prevalent in the south western portion of the northern Eastern Lease, and the central and western portion of the southern Eastern Lease. Within these low-lying areas of the site, (which are largely vegetated by low woodland and shrubland), and along streams (where closed forest predominates), groundwater is located close to the ground surface. Across broad areas it is two to several metres below the ground surface (refer to the EIS Groundwater Report).

The extensive shallow groundwater areas have had a marked influence on vegetation structure and vegetation composition. Broad areas of stunted *E. tetradonta* low open forest and woodland (mapped as MU16 on **Figure 15**) occur in areas with shallow groundwater. Although *E. tetradonta* can grow to a tree greater than 20 metres in height, where groundwater is shallow it appears to remain as a stunted shrub, in many areas reaching only 2 metres in height.

In the shallow groundwater areas there are also sizeable occurrences of other woodlands in which various paperbark species (*Melaleuca* spp) and sedges are prominent (MU10a - *Melaleuca viridiflora/Corymbia polycarpa* open forest and MU31 - *Eucalyptus tectifica* open woodland, refer to **Figure 15**).

The Amagula River, as well as a section of Emerald River – Tributary 2 and a section of Amagula Tributary 1 appear to be fed by groundwater. They continue to flow even in the peak of the dry season within their lower reaches (refer to the EIS Aquatic Ecology Report). The perennial reaches of these rivers are shown in **Figure 10**. Where such groundwater flows sustain river flows, there is also a difference in the vegetation, with tall swamp forest



with rainforest elements occurring (MU11 - *Melaleuca leucadendra/Dillenia alata* open forest, refer to **Figure 15**).

In one small, highly localised patch, rainforest that is surrounded by drier, regularly burnt woodland occurs (MU3 Dry sub-coastal monsoon rainforest, refer to **Figure 15**). Within this area, it seems apparent that some localised occurrence of shallow groundwater is sustaining the rainforest patch and preventing it from succumbing to fire. In particular, this vegetation is likely to be located above a localised lens of perched groundwater.

The shallow groundwater and the expression of the groundwater to feed the larger rivers during the dry season therefore is a key factor in shaping the vegetation and faunal habitats of the project site.

In summary, MU3, MU10a, MU11 and MU16 appear to be associated with occurrences of shallow groundwater.

## Results: Fauna

### 6.1 Fauna Habitats

The project site contains extensive areas of remnant vegetation which provide a range of habitats for fauna species. The matrix of fauna habitats within the project site occur within the various vegetation communities, topographical formations and water resources (permanent and ephemeral). The habitat features are numerous and provide potential foraging, shelter and breeding opportunities for a suite of fauna species. Key habitats identified within the project site include:

- Closed forest (rainforest) habitats;
- Open forest habitats;
- Sandstone woodland and rock outcrops;
- Woodland/shrubland habitats; and
- Riparian/seasonal wetland/aquatic habitats.

The extent of these habitats within the project site is summarised in **Table 6.1** and shown in **Figure 16**. Each of these habitats is discussed below. The habitat at each fauna survey site is described in **Appendix G**. The aquatic habitats are described in detail in the EIS Aquatic Ecology Report.

**Table 6.1 Fauna Habitats within the Project Site**

Habitat Types	Mapping Units	Area (ha) <sup>1</sup>	% of Project Site
Closed forest (rainforest) habitats	MU3	0.7	0.02
Open forest habitats	MU4, MU5	3,172.2	69.24
Sandstone woodland and rock outcrops	MU18	557.5	12.17
Woodland/shrubland habitats	MU16, MU17, MU31	575.5	12.56
Riparian/seasonal wetland/aquatic habitats	MU10a, MU10b, MU11, MU15a, MU20, MU24,	275.7	6.02
<b>TOTAL (nearest hectare)</b>		<b>4,582</b>	<b>100</b>

<sup>1</sup> Based on groundtruthing

### 6.1.1 Closed Forest (Rainforest) Habitats

True closed forest covers less than 1% of the project site and is restricted to a small patch of monsoon vine thicket in the southern portion of the Southern EL. The relative rarity of rainforest on the project site is likely due to the prevalence of fires, which regularly impact most of the island. Closed forest (rainforest) only occurs in restricted unburnt areas. Some riparian vegetation, described in the sections below, also has elements of rainforest in it. Such closed forest habitat occurs in isolated areas of the larger watercourses of the project site where the stream flow is perennial.

Closed forest includes large tree species as *Dillenia alata* (Red Beech), *Canarium australianum* (Mango Bark) and *Melaleuca leucadendra* (Cajeput Tree), some of which form large hollows. As closed forest is associated with moderate to high moisture (or mesic) conditions and reliable water, it is likely to support a different assemblage of fauna to other habitats on the project site.

Features of this habitat type are summarised in **Table 6.2**, and a photograph of the closed forest (rainforest) habitat within the project site is shown in **Photograph 6.1**.

**Table 6.2 Features of Closed Forest (Rainforest) Habitats within the Project Site**

Feature	Comment
Area	Less than 1% of project site
Physiographic location	Small pockets protected from fires
Soils	High proportion of surface rocks and gravel, with organic material and debris on the rock surface. Soils are not accessible due to the rocky substrate
Water	Associated with permanent water or shallow groundwater
Tree hollows and fallen logs	Large trees with hollows typically present
Key microhabitats	Forest canopy, supporting a diversity of tree and liana types (i.e. long-stemmed woody vines that are rooted in the soil at ground level, and which utilise the trees in order to climb up to the canopy)
Values for wildlife	Sheltered, constant microclimate, diversity of plant food resources



**Photograph 6.1**      **Closed Forest (Rainforest) Habitat within the Southern EL (June 2014)**

### **6.1.2**    *Open Forest*

The main fauna habitat within the project site comprises open forest dominated by *Eucalyptus tetradonta* and *Eucalyptus miniata* on undulating sandy plains. Making up approximately 69% of the project site, the extensive areas of open forest habitats provide numerous important habitat features that would be suitable for a suite of fauna species, including a number of the threatened fauna known or predicted to occur within the project site.

Habitat features within the open forest habitats include a diversity of grasses for seed-eating species, a shrubby understorey for birds and taller eucalypt trees. Hollow bearing trees of varying sizes are present in these areas, although not in abundance, likely due to the frequency of fire. The tree hollows and stags within the project site provide shelter, roosting and nesting habitat for a number of arboreal fauna species, including microbats and gliders, diurnal birds, owls and some reptiles. Previous studies of the project site have identified locations of large hollow-bearing trees suitable for use by the Masked Owl (northern) (EMS, 2013; EMS, 2014b).

Terrestrial features such as fallen logs, debris and leaf litter provide shelter for many of the small to medium sized terrestrial fauna species known from the project site. However, there is also a paucity of coarse woody debris on the ground due to the frequency of fire.

Features of this habitat type are summarised in **Table 6.3**. An example of open forest habitat within the project site is shown in **Photograph 6.2**.

**Table 6.3 Features of Open Forest Habitat within the Project Site**

Feature	Comment
Area	Covers 69% of project site - most extensive habitat
Physiographic location	Gently undulating sand plains
Soils	Dark brown to reddish brown loamy sands
Water	Well drained, relatively dry forest habitats
Fire	Frequently and extensively burnt (annually or biennially)
Tree hollows and fallen logs	Large trees with hollows typically present
Key microhabitats	Forest canopy, subcanopy, shrub layer and grassy ground stratum well developed
Values for wildlife	Diverse array of plant food resources

**Photograph 6.2 Open forest habitat within the proposed haul road corridor (October 2014)**



### 6.1.3 Sandstone Woodland and Rock Outcrops

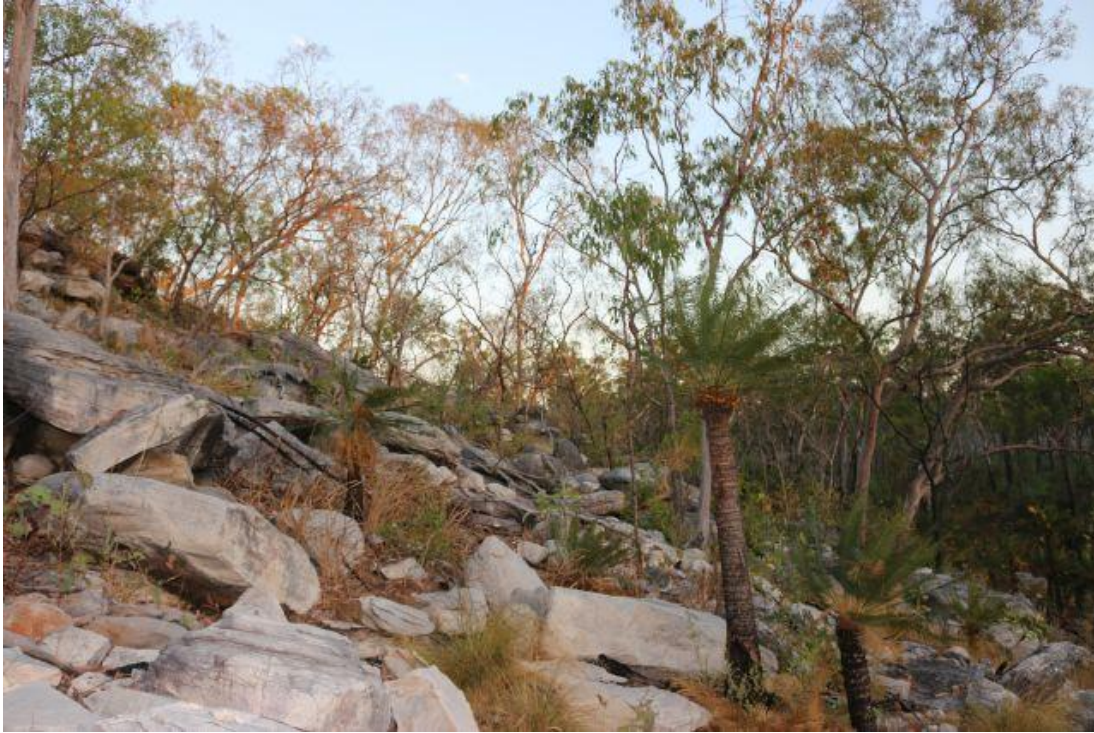
Sandstone woodland is widespread on the low hills of the project site. These woodlands are characterised by the presence of numerous rocky outcrops with extensive areas of bare rock. Covering approximately 12% of the project site, the dominant vegetation comprises small trees, principally *Eucalyptus tetradonta* and *E.ferruginea*.

These areas provide high quality habitat for mammals and reptiles (shelter habitat in the form of rocky outcrops, rock slabs, cracks, crevices, and caves). Mammals and reptiles recorded utilising these habitats in the project site include the Common Rock-rat (*Zyromys argurus*), the Agile Wallaby (*Macropus agilis*), Bynoe's Gecko (*Heteronotia binoei*), and the Bauxite Rainbow-skink (*Carlia amax*). The Northern Quoll (*Dasyurus hallucatus*) was also observed utilising this habitat, and these areas are considered to provide high quality habitat for this species, in particular for denning and shelter.

Features of this habitat type are summarised in **Table 6.4**. An example of the sandstone woodland and rock outcrops habitat in the dry season within the project site is shown in **Photograph 6.3**.

**Table 6.4 Habitat Features of Sandstone Woodland and Rock Outcrops within the Project Site**

Feature	Comment
Area	Covers 12% of the project site
Physiographic Location	Low sandstone hills
Soils	Shallow, if non-existent, gravelly and often rocky clayey sand over quartz sandstone with minor Leptic Rudosols
Water	Water is scarce - though may be present amid deeper rock outcrops
Tree hollows and fallen logs	Few trees with hollows typically present
Key microhabitats	Various shelters amid rocks including crevices, caves and boulder piles
Values for wildlife	Rocky shelters providing refugia from heat and fire, diversity of plant food resources



**Photograph 6.3**      **Sandstone Woodland on rocky hillside within the Southern EL (October 2014)**

#### **6.1.4**    **Woodland/Shrubland Habitats**

Within the project site, woodland/shrubland habitats occur within flat or gently undulating sand plains where the water table is close to the surface and/or where the landscape receives some seasonal flooding (but is not riparian). Without considerable ground truthing, these habitats are not readily distinguishable from the various forms of open forest, and as such, this habitat type is not described as one of the island-wide broad habitats within **Section 4.1.6**. Ground-truthing of the vegetation and associated habitats within the project site has allowed for the differentiation of this habitat type which covers approximately 12% of the project site.

Woodland and shrubland habitats within the project site are dominated by a range of tree species including *Eucalyptus tetradonta*, *Eucalyptus tectifera*, *Corymbia polycarpa* and *Melaleuca* spp. These areas consist of low growing trees and shrubs and transition from woodland structure to dense shrubland as the groundwater table depth decreases. In areas of very poor drainage, the canopy stratum is expressed as a shrub layer of stunted or regenerating trees. These habitats contained limited terrestrial features such as trees with hollows and hollow logs. Shrub and ground cover is high within these areas.

Features of this habitat type are summarised in **Table 6.5**. Examples of woodland/shrubland habitat within the project site are shown in **Photograph 6.4** and **Photograph 6.5**.





**Table 6.5 Habitat Features of Woodland/Shrubland Habitats within the Project Site**

Feature	Comment
Area	Covers 12% of project site
Physiographic location	Lower relief areas between open forest and riparian areas
Soils	Brownish black loamy sands
Water	Associated with shallow groundwater or seasonal flooding
Fire	Frequently and extensively burnt (annually or biennially)
Tree hollows and fallen logs	Some trees with hollows present in woodland; absent from shrubland
Key microhabitats	- Tree canopy, and abundant shrub species - Some woodland has well developed grass and sedge areas
Values for wildlife	Diverse array of plant food resources



**Photograph 6.4 Woodland of *Eucalyptus tectifica* within the haul road corridor of the project site (May 2014)**



**Photograph 6.5** Shrubland dominated by dense regenerating or stunted *Eucalyptus tetrodonta* within the Southern EL (May 2014)

### **6.1.5 Riparian/Seasonal Wetland/Aquatic Habitats**

#### *i. Riparian and Seasonal Wetland Habitats*

Sections of several watercourses, including the upper reaches of the Emerald and Amagula Rivers and their tributaries occur within the project site. The majority of the riparian habitat in the project site is represented by ephemeral watercourses that only flow when sufficient rain has fallen. These flow during the wet season, however all but the deepest pools dry out during the dry season.

Most of the watercourses contained water in the May 2014 surveys as this was conducted shortly after the end of the wet season, and water was widespread in the landscape. The October 2014 field surveys were conducted towards the end of the dry season, and water in the landscape had been significantly reduced. Many areas that contained flowing water in the May survey were reduced by the October survey to small, non-flowing pools and many locations were dry, with no surface water visible. The temporary pools of water that were available would provide a valuable drinking source in hot and dry months.

Other kinds of aquatic habitat present in the project site include seasonal wetlands that form in the wet season and dry out in the dry season. These form short-lived seasonal swamps supporting sedges, rushes and grasses. The riparian areas contain woody debris, standing trees, macrophytes and fringing vegetation such as reeds and rushes. They are likely to provide suitable habitat for a range of amphibians and waterbirds, including migratory wetland birds.



Features of this habitat type are summarised in **Table 6.6**. An example riparian habitat following the wet season (in May 2014) within the project site is shown in **Photograph 6.6**.

**Table 6.6 Features of Riparian Habitats within the Project Site**

Feature	Comment
Area	Less than 2% of project site
Physiographic location	Along watercourses
Soils	Brownish back to dark black sandy clay loams to silty loams
Water	Associated with permanent or seasonally flowing watercourses
Fire	Larger, perennial sections of watercourses provide protection against fires, but most smaller seasonal watercourses support riparian vegetation that is regularly burnt
Tree hollows and fallen logs	Large trees with hollows present along larger watercourses
Key microhabitats	- Watercourses/water - Forest canopy, supporting a diversity of tree and liana types - Riparian and aquatic plants present
Values for wildlife	Water resources plus diversity of plant food resources



**Photograph 6.6 Riparian habitat within the Southern EL – part of the Amagula River (May 2014)**



## ii. Aquatic Habitats

Aquatic habitats are discussed in detail in the EIS Aquatic Ecology Report.

## 6.2 Fauna Species: Overview

In total, 116 fauna species have been recorded from the project site during the current study, including six amphibians, 54 birds, 25 mammals and 31 reptiles. A discussion of the faunal diversity recorded from the project site is presented below. A complete list of all the fauna species that have been recorded from the project site is presented in **Appendix I**. A suite of other fauna species have been recorded in the vicinity of the project site by URS (2012) and Webb (1992), the results of which are also presented in **Appendix I**.

A separate study of the fauna within mine rehabilitation areas of the existing GEMCO mine was also undertaken in October 2014 and the results are presented in a separate report within **Appendix B**. The objectives of the separate fauna study were to identify the fauna species present with the surveyed mine rehabilitation areas and to provide a comparison of the utilisation of the habitat within mine rehabilitation areas by fauna in relation to the faunal assemblage occurring within the project site.

The results outlined in the following sections therefore only relate to fauna studies undertaken within the project site.

### 6.2.1 Amphibians

Six amphibians were recorded within the project site during surveys and were recorded in areas of suitable habitat along watercourses. The Remote Froglet (*Crinia remota*) was the most commonly encountered species within the project site. Other species recorded included Floodplain Toadlet (*Uperoleia inundata*) and Northern Dwarf Tree Frog (*Litoria bicolor*).

No threatened amphibians listed under the EPBC Act and/or the TPWC Act have been recorded from the project site or from database searches and none are considered likely to occur.

### 6.2.2 Birds

The project site supports a suite of bird species, however diversity is generally considered low due to the dominance of one broad habitat type, namely open forest, within the project site. A total of 54 bird species were recorded within the project site during surveys. Given the uniformity of much of the habitat within the project site, this level of bird diversity is expected.

The vast majority of bird species were common and widespread, and typical of woodland environments. Dominant families within the project site include Meliphagidae (honeyeaters and friarbirds), Columbidae (pigeons and doves) and Pachycephalidae (whistlers and shrike-thrushes). Commonly recorded species include Torresian Crow (*Corvus orru*), Rainbow Lorikeet (*Trichoglossus haematodus*), Brown Honeyeater (*Lichmera indistincta*), Bar-



shouldered Dove (*Geopelia humeralis*), Silver-crowned Friarbird (*Philemon argenticeps*), Blue-winged Kookaburra (*Dacelo leachii*) and Red-winged Parrot (*Aprosmictus erythropterus*).

The following threatened and/or migratory birds were recorded during surveys:

- Masked Owl (northern) (*Tyto novaehollandiae kimberli*); and
- Rainbow Bee-eater (*Merops ornatus*).

Further discussion of these species is provided below in **Section 6.3**.

### **6.2.3 Mammals**

A total of 25 mammal species were recorded during the field surveys, including 12 terrestrial species, one non-flying arboreal species, 11 microbats and one megachiropteran bat (flying-foxes). Of these species, two are exotic species (see **Section 6.2.5**). The most common and widespread terrestrial mammals within the project site included the Northern Quoll (*Dasyurus hallucatus*) and Agile Wallaby (*Macropus agilis*). Other commonly occurring native terrestrial mammals include the Northern Brown Bandicoot (*Isodon macrourus*) and Delicate Mouse (*Pseudomys delicatulus*). The only non-flying arboreal mammal recorded within the project site during surveys, the Sugar Glider (*Petaurus breviceps*) was also commonly observed. Several microbats were positively identified including the Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*) and Northern Cave Bat (*Vespadelus caurinus*). A roost of the Black Flying-fox (*Pteropus alecto*), which was recorded within vine forest habitat, was the only species of flying-fox observed during the surveys.

The following threatened mammals were recorded during surveys:

- Brush-tailed Rabbit-rat (*Conilurus penicillatus*);
- Northern Quoll (*Dasyurus hallucatus*); and
- Northern Hopping-mouse (*Notomys aquilo*).

Further discussion of these species is provided below in **Section 6.3**.

### **6.2.4 Reptiles**

A range of habitat features suitable for reptiles occurs throughout the project site. A total of 31 reptile species were recorded within the project site. The dominant family within the project site was Scincidae (skinks), with other families present including Varanidae (monitors/goannas) and Agamidae (dragons). Commonly recorded reptiles include the Common Dwarf Skink (*Menetia greyii*), Mertens' Water Monitor (*Varanus mertensi*), Two-lined Dragon (*Diporiphora bilineata*), Bynoe's Gecko (*Heteronotia binoei*), Bauxite Rainbow-skink (*Carlia amax*), Péron's Snake-eyed Skink (*Cryptoblepharus plagiocephalus*) and Spalding's Ctenotus (*Ctenotus spaldingi*). Snakes were more frequently observed in the May/June 2014 survey and included the Diamond Python (*Morelia spilota*) and Northern Brown Snake (*Pseudonaja nuchalis*).



The following threatened and/or migratory reptiles were recorded during surveys:

- Yellow-spotted Monitor (*Varanus panoptes*);
- Mertens' Water Monitor (*Varanus mertensi*); and
- Salt-water Crocodile (*Crocodylus porosus*).

Further discussion of these species is provided below in **Section 6.3**.

### **6.2.5 Exotic / Feral Species**

Groote Eylandt represents a unique faunal refuge in that exotic and feral species such as feral cattle, horses, donkeys, pigs, goats, Water Buffalo, the Cane Toad and Rusa Deer are not established on the island.

Only a few exotic species were recorded during surveys of the project site, and sightings were infrequent. This included Domestic Dogs/Dingoes (*Canis familiaris/lupus*) and Feral Cats (*Felis catus*).

## **6.3 Fauna Species: Threatened and/or Migratory Species**

A suite of threatened fauna species were recorded within the project site during the current study and their locations are shown on **Figure 17**. In some instances, there were multiple sightings of a particular species at a single location, however only one of these records is shown in the figure. The locations of threatened fauna species held within the InfoNet database across Groote Eylandt are shown on **Figure 13**.

**Table 6.7** summarises the threatened and migratory species recorded within the project site (during this survey or previous surveys). The table does not include PMST results because the PMST is not restricted to species that have been recorded within the search area as it also includes species with potential to occur, or with the potential for their habitat to occur, based on broadscale habitat modelling.

**Appendix F** analyses the likelihood of occurrence within the project site for each of the threatened species listed in database searches. **Table 6.7** provides a summary of the likelihood of occurrence. The sections below provide details of the threatened fauna species that have been recorded within the project site, or which have a moderate to high potential to occur.



**Table 6.7 Summary of the Likelihood of Occurrence of Threatened and Migratory Fauna Species within the Project Site**

Common Name	Scientific Name	EPBC Act Status <sup>1</sup>	TPWC Act Status <sup>1</sup>	Species Records within the Project Site			Likelihood of Occurrence
				Current Survey	InfoNet	Other Surveys	
<b>Birds</b>							
Red Knot	<i>Calidris canutus</i>		V				Low
Curlew Sandpiper	<i>Calidris ferruginea</i>		V				Low
Great Knot	<i>Calidris tenuirostris</i>		V				Low
Greater Sand Plover	<i>Charadrius leschenaultii</i>		V				Low
Lesser Sand Plover	<i>Charadrius mongulus</i>		V				Low
Red Goshawk	<i>Erythrotriorchis radiatus</i>	V					Low
Gouldian Finch	<i>Erythrura gouldiae</i>	E	V				Low
Partridge Pigeon	<i>Geophaps smithii</i>	V	V				Low
Bar-tailed Godwit	<i>Limosa lapponica</i>	M(m)	V				Low
Eastern Curlew	<i>Numenius madagascariensis</i>		V				Low
Masked Owl (northern)	<i>Tyto novaehollandiae kimberli</i>	V	V	x		x*	Present
Fork-tailed Swift	<i>Apus pacificus</i>	M(m)					Moderate
Streaked Shearwater	<i>Calonectris leucomelas</i>	M(m)					Low
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	M(t)					Moderate
Barn Swallow	<i>Hirundo rustica</i>	M(t)					Low
Rainbow Bee-eater	<i>Merops ornatus</i>	M(t)		x	x		Present
Rufous Fantail	<i>Rhipidura rufifrons</i>	M(t)					Moderate
Eastern Great Egret	<i>Ardea modesta</i>	M(w)					Low
Cattle Egret	<i>Ardea ibis</i>	M(w)					Low
Oriental Plover	<i>Charadrius veredus</i>	M(w)					Low
Oriental Pratincole	<i>Glareola maldivarum</i>	M(w)					Low

Common Name	Scientific Name	EPBC Act Status <sup>1</sup>	TPWC Act Status <sup>1</sup>	Species Records within the Project Site			Likelihood of Occurrence
				Current Survey	InfoNet	Other Surveys	
<b>Mammals</b>							
Brush-tailed Rabbit-rat	<i>Conilurus penicillatus</i>	V	E	x	x	x	Present
Northern Quoll	<i>Dasyurus hallucatus</i>	E	CE	x	x		Present
Northern Hopping-mouse	<i>Notomys aquilo</i>	V	V	x	x	x <sup>^</sup>	Present
Pale Field Rat	<i>Rattus tunneyi</i>		V				Low
Water Mouse	<i>Xeromys myoides</i>	V					Low
<b>Reptiles</b>							
Plains Death Adder	<i>Acanthopis hawkei</i>	V					Low
Yellow-spotted Monitor	<i>Varanus panoptes</i>		V	x			Present
Mertens' Water Monitor	<i>Varanus mertensi</i>		V	x			Present
Salt-water Crocodile	<i>Crocodylus porosus</i>	M(m)		x			Present

<sup>1</sup> Conservation Status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory [(m) = marine, (t) = terrestrial, (w) = wetland]

<sup>\*</sup>=EMS, 2013,

<sup>^</sup>=Coffey, 2012





### **6.3.1 EPBC Act Species (Threatened)**

Four threatened fauna species listed under the EPBC Act are known to occur within the project site, including the Masked Owl (northern), Brush-tailed Rabbit-rat, Northern Quoll and Northern Hopping-mouse. Details on these species, their occurrence and habitat within the project site are provided below. No other EPBC Act listed threatened fauna species are considered to have a moderate or high likelihood of occurrence within the project site, and as such, are not assessed further within this report.

#### **Masked Owl (northern)**

**EPBC Act Status:** Vulnerable

**TPWC Act Status:** Vulnerable

#### ***Species Overview***

The Masked Owl (northern) has been recorded from riparian forest, rainforest, open forest, Melaleuca swamps and the edges of mangroves, as well as along the margins of sugar cane fields (DotE, 2014f). The species occurs mainly in tall eucalypt open forests (especially those dominated by *Eucalyptus miniata* (Darwin Woollybutt) and *E. tetradonta* (Darwin Stringybark) and also forages in more open vegetation types, including grasslands (Woinarski and Ward, 2012a). Roosting habitat occurs in dense foliage, including within monsoon rainforests, however it more typically roosts and nests in tree hollows (Woinarski and Ward, 2012a). Critical habitat for this species is not defined due to a lack of records, however this species is considered to be dependent on tree hollows (Woinarski, 2004b). Mammals that are up to the size of possums form the primary component of the diet of this species (Higgins, 1999). The distribution of the Masked Owl (northern) is imperfectly known, with remarkably few records across its broad range (Woinarski, 2004b). The Masked Owl (northern) has been impacted by broad-scale changes to the environment of northern Australia caused by altered fire regimes, grazing by livestock and feral animals, and the invasion of native woodlands by exotic plants, particularly introduced pasture grasses (DotE, 2014f).

#### ***EPBC Act Plans***

##### *i. Conservation Advice*

There is no Approved Conservation Advice for the Masked Owl (Northern).

##### *ii. Recovery Plan*

A National Multi-species Recovery Plan has been prepared for several bird species, including the Masked Owl (Northern) (Woinarski, 2004b). The recovery plan lists a series of objectives and actions, including establishment of a recovery team, or equivalent, undertaking research that assesses the population size, distribution and habitat requirements for the Masked Owl and the development of appropriate monitoring programs.



### iii. Threat Abatement Plan

There are no Threat Abatement Plans in place for the Masked Owl (northern). However, the DotE Species Profile and Threats Database acknowledges that land clearance is a key threatening process.

#### **Presence and Habitat within the Project Site**

The Masked Owl (northern) was recorded from a total of four locations within the project site during the current study, using call playback and spotlighting (**Figure 17**). A photograph of a Masked Owl photographed in open forest in the south-eastern leases is shown in **Photograph 6.7**. This species was recorded at two locations within the Northern EL and two locations within the Southern EL, within vegetation community MU4. All records of this species during the current survey were made during the May/June 2014 survey period. The Masked Owl (northern) was previously recorded at 10 locations within the project site by EMS (2013) during a survey in June 2013.

Within the project site, the majority of the fauna habitat types listed in **Table 6.1** have the potential to provide habitat resources for this species. Key foraging habitat resources are present and consist of a high density of potential prey species such as small- to medium-sized ground-dwelling mammals, including the Northern Brown Bandicoot (*Isodon macrourus*) and the Northern Quoll (*Dasyurus hallucatus*), as well as habitats containing the Sugar Glider (*Petaurus breviceps*). Roosting and nesting habitat for this species is present in the denser closed forest (rainforest) habitats, and in areas containing hollow-bearing trees with medium- to large-sized hollows such as open forests, sandstone woodlands and rock outcrops, and riparian habitats. The species is not likely to roost or nest in woodland/shrubland habitat due to the lack of dense canopy and large hollow-bearing trees, but may forage within this habitat. Pre-clearing assessments undertaken by EMS (2013; 2014a) have recorded the highest density of hollows within *Eucalyptus tetradonta* (Darwin Stringybark), *Eucalyptus miniata* (Darwin Woollybutt) and stags. Hollows assessed as suitable for the Masked Owl (northern) within the project site were typically located in the main trunk of these trees, with other locations recorded in large branches (EMS, 2014b).



**Photograph 6.7 Masked Owl photographed in open forest in the south-eastern leases.**

### **Brush-tailed Rabbit-rat**

**EPBC Act Status:** Vulnerable

**TPWC Act Status:** Endangered

### ***Species Overview***

The Brush-tailed Rabbit-rat appears to have quite specific habitat requirements and is largely restricted to mixed eucalypt open forest and woodland, or on dunes with *Casuarina* (Threatened Species Scientific Committee, 2008). Preference appears to be given to habitats that are not burnt annually, that have an understorey of predominantly perennial grasses and a sparse-to-moderate middle storey (Threatened Species Scientific Committee, 2008). It shelters in tree hollows, hollow logs and, less frequently, in the crowns of pandanus or sand-palms (Woinarski and Hill, 2012a). Most foraging is on the ground, but it is also partly arboreal (Woinarski and Hill, 2012a). Their mean home range size is approximately 1 ha and males typically have larger home ranges than females (Firth, 2007). The diet of the Brush-tailed Rabbit-rat consists primarily of seed, particularly from perennial grasses (Firth, 2007) with some fruits, invertebrates and leaves (Woinarski and Hill, 2012a). Within the Northern Territory this species is known to persist only on the Cobourg Peninsula, Bathurst, Melville and Inglis Islands, and Groote Eylandt (Woinarski and Hill, 2012a). Threats to the Brush-tailed Rabbit-rat include habitat alteration due to inappropriate fire regimes and grazing by introduced herbivores, habitat destruction resulting from forestry and mining operations and predation by feral cats (DotE, 2013j).



### **EPBC Act Plans**

#### *i. Conservation Advice*

Approved Conservation Advice for the Brush-tailed Rabbit-rat has been prepared, which identifies research and action priorities to manage and monitor the species. This includes assessing threatening processes such as inappropriate fire regimes and predation by feral cats.

#### *ii. Recovery Plan*

There is no Recovery Plan available for the Brush-tailed Rabbit-rat, however, the DotE Species Profile and Threats Database acknowledges that a recovery plan is required.

#### *iii. Threat Abatement Plan*

A Threat Abatement Plan is in place for the Brush-tailed Rabbit-rat for the threat of Feral Cats.

### **Presence and Habitat within the Project Site**

The Brush-tailed Rabbit-rat was recorded from one location within the project site during the current study using an IR camera (**Figure 17**). A photograph of a Brush-tailed Rabbit-rat recorded on IR camera within the project site is shown in **Photograph 6.8**. The site is located in the south-eastern portion of the Southern EL within vegetation community MU4. The Brush-tailed Rabbit-rat has been recorded previously within the project site by Ward (2007a) and EMS (2013). An additional record of this species is noted in the InfoNet database (DLRM, 2014d) in the Southern EL from 2005, and is located in close proximity to the record of the Brush-tailed Rabbit-rat recorded during the current survey. Recent surveys (2005-2010) on Groote Eylandt have captured few animals, leading to the conclusion that the population on Groote may now be quite small (Woinarski and Hill, 2012a).

Within the project site, the species has the potential to inhabit several of the habitat types listed in **Table 6.1**. The Brush-tailed Rabbit-rat has potential to occur within closed forest (rainforest) habitats, open forests, sandstone woodland and rock outcrops and riparian habitats. The species would use these habitat types for shelter, breeding and foraging; however the suitability of habitat present is reduced in areas where fire frequency is high (burnt annually). In areas that are less frequently burnt, woodland habitats of *Eucalyptus tetradonta* (Darwin Stringybark) and *Eucalyptus miniata* (Darwin Woollybutt) with a sparse shrub layer and grassy understorey would provide suitable habitat for this species. Sheltering habitat is present within the project site in the form of tree hollows, fallen hollow logs and pandanus palms. Woodland/shrubland habitat is not considered likely to support a large population of the species due to the lack of large hollow-bearing trees and limited ground debris suitable for sheltering. The species would use water sources when available.

Despite the abundance of suitable habitat within the project site, the Brush-tailed Rabbit-rat has not been frequently recorded. Firth (2008) suggests that the high densities of the



Northern Quoll (*Dasyurus hallucatus*), which is known to predate the Brush-tailed Rabbit-rat, has caused very highly localised extinctions of this species in pockets of Groote Eylandt.



**Photograph 6.8 Brush-tailed Rabbit-rat detected by an IR camera**

### **Northern Quoll**

**EPBC Act Status:** Endangered

**TPWC Act Status:** Critically Endangered

### **Species Overview**

The Northern Quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert (DotE, 2013I). Northern Quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats with high structural diversity used for foraging and dispersal (DotE, 2013I). Rocky areas are considered as prime habitat for the Northern Quoll (Hill and Ward, 2010). Den sites include rocky outcrops and crevices, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings (Hill and Ward, 2010; DotE, 2013I). During the non-breeding season, home ranges are about 35 ha, but this increases to about 100 ha for males in the breeding season (Woinarski and Hill, 2012b). They are opportunistic omnivores that feed on a broad range of items, including beetles, grasshoppers, spiders, scorpions, centipedes, fruit and nectar, switching dietary resources according to season and availability (Hill and Ward, 2010; DotE, 2013I). The current distribution is discontinuous across northern Australia, with core populations in rocky and/or high rainfall areas (Hill and Ward, 2010), however there has been a decline across much of this range (Woinarski and Hill, 2012b). It is known from a number of offshore islands, including Groote Eylandt (Hill and Ward, 2010). Key threats to the Northern Quoll include lethal toxic ingestion caused by Cane Toads, removal,



degradation and fragmentation of habitat, inappropriate fire regimes, weeds and feral predators (DotE, 2013I).

### ***EPBC Act Plans***

#### *i. Conservation Advice*

There is no Approved Conservation Advice for the Northern Quoll.

#### *ii. Recovery Plan*

A National Recovery Plan for the Northern Quoll has been prepared (Hill and Ward, 2010). The plan lists a series of objectives and actions to manage existing populations of the species, including the protection of quoll populations on offshore islands from invasion and establishment of cane toads, cats and other potential predators.

#### *iii. Threat Abatement Plan*

A Threat Abatement Plan is in place for the Northern Quoll for the threat of the European Red Fox. This plan is not relevant in the context of Groote Eylandt, given the European Red Fox is not present on the island.

### ***Presence and Habitat in the Project Site***

A total of 65 Northern Quolls were recorded from 22 locations within the project site during the current study using Elliott trapping, cage trapping, IR cameras and incidental spotlighting (**Figure 17**). A photograph of a Northern Quoll captured during trapping surveys within the project site is shown in **Photograph 6.9**. This species was recorded within the Southern EL, Northern EL and haul road corridor, in a suite of vegetation communities, including MU4, MU5, MU10a, MU11, MU16, MU17, MU18 and MU20. The Northern Quoll has also been recorded within mine rehabilitation areas (see **Appendix B**). During previous surveys, the Northern Quoll has been recorded numerous times within and in close proximity to the project site (Webb, 1992; Ward, 2006b; Firth, 2008; Smith, 2009b; URS Australia Pty Ltd, 2012). Additional records of this species are held in the InfoNet database (DLRM, 2014d) from the Southern EL.

Due to the range of habitat this species is known from, all of the habitat types listed in **Table 6.1** occurring within the project site are considered to provide potential suitable habitat for this species. Key areas of habitat are located in proximity to rocky habitats in vegetation with high structural diversity, especially sandstone woodland and rock outcrop habitat. Other habitat types such as closed forest (rainforest), open forest, woodland/shrubland, aquatic and riparian habitats also provide den habitat in the form of tree hollows, hollow logs and termite mounds, in addition to suitable habitat for prey species such as other small mammals, frogs, reptiles and invertebrates. The results of the current study indicate that the Northern Quoll occurs extensively within the project site, utilising the available habitats for foraging and breeding. The individuals caught during the October 2014 survey period were all female carrying young. Smith (2009b) noted that the Northern Quoll appears to be widely distributed across Groote Eylandt.



**Photograph 6.9 Northern Quoll captured during trapping surveys**

**Northern Hopping-mouse**

**EPBC Act Status:** Vulnerable

**TPWC Act Status:** Vulnerable

***Species Overview***

The Northern Hopping-mouse is most often found in areas with sandy substrates and seems to favour coastal sand dunes and sand sheets with a cover of tussock grass or heath (DotE, 2013t). It is also found in shrubland, eucalypt open forest, and the margins of coastal rainforest thickets (DotE, 2013t). It constructs elaborate communally-used burrow systems, whose vertical entrances may be obscured by a thin layer of sand (Diete *et al.*, 2014; Woinariski and Ward, 2012b). Burrows are unmarked by entrances or tracks (Ward, 2014). The Northern Hopping-mouse is active at night and it forages entirely on the ground (Woinariski and Ward, 2012b). It feeds mainly on a range of seeds from grasses, herbs and shrubs and it is also known to eat insects (DotE, 2013t). The Northern Hopping-mouse is restricted to the monsoonal tropics of northern Australia and is found on Groote Eylandt, and in the central and north-east Arnhem Land mainland (DotE, 2013t). Key threats to the Northern Hopping-mouse include predation by feral cats, habitat modification by feral stock, broad-scale strip mining and changes in fire regimes (DotE, 2013t).



### **EPBC Act Plans**

#### *i. Conservation Advice*

There is no Approved Conservation Advice for the Northern Hopping-mouse.

#### *ii. Recovery Plan*

A National Multi-species Recovery Plan has been prepared to inform the monitoring and management of the Northern Hopping-mouse and other small mammals (Woinarski, 2004a). The plan sets out several objectives and actions to assist with the management of extant populations and the reduction of key threatening processes.

#### *iii. Threat Abatement Plan*

There are no Threat Abatement Plans in place for the Northern-hopping Mouse.

### **Presence and Habitat in the Project Site**

The Northern Hopping-mouse was recorded from one location during the current study during incidental spotlighting (**Figure 17**). A photograph of the Northern Hopping-mouse captured during incidental spotlighting surveys within the project site is shown in **Photograph 6.10**. The location of the record is immediately adjacent to the northern portion of the haul road corridor within vegetation community MU4. The Northern Hopping-mouse has been recorded numerous times within and in close proximity to the project site during previous surveys, including Coffey Environment Pty Ltd (2010), Ward (2007b), Ward (2007a) and Ward (2006b). Previous surveys have recorded the apparent presence of the Northern Hopping-mouse based upon the presence of spoil heaps (e.g. Firth (2008) and Smith (2009a)) and a number of the records held in the InfoNet database within the project site appear to correlate to these spoil heaps. It has since been determined that the presence of spoil heaps is not a reliable determinate for the presence of the Northern Hopping-mouse as spoil heaps are also created by the Delicate Mouse (Coffey Environments Pty Ltd, 2010), which is prevalent on Groote Eylandt, and was also recorded within the project site during the current study.

Woodlands and open forests with a grassy understorey are considered to provide suitable habitat for the Northern Hopping-mouse, in particular areas with a sandy substrate and in proximity to white rock. A sandy substrate is required for this species to dig burrows (Dieter *et al.*, 2014). The grassy understorey of woodlands and open forests within the project site would provide a range of foraging opportunities for this species. It is expected that this species both forages and breeds within the project site. Habitat types occurring within the project site in which the species is considered likely to occur are restricted to open forest, and sandstone woodland and rock outcrops (Firth, 2008). These habitat types contain suitable foraging and shelter resources for the species, in the form of grasses and habitat for invertebrates, and soils suitable for the creation of burrows.

Habitat types such as woodland/shrubland, seasonal wetlands and riparian habitats are seasonally inundated and have high water tables, thus are considered unsuitable for burrow





formation. Additionally, closed forest habitats typically have a significant rocky ground surface with denser moist soils, which are not considered optimal for burrow formation.



**Photograph 6.10 Northern Hopping-mouse captured during incidental spotlighting surveys**

### **6.3.2 EPBC Act Species (Migratory)**

Two migratory fauna species listed under the EPBC Act have been recorded within the project site during the EIS field surveys, namely the Salt-water Crocodile and Rainbow Bee-eater. Although not recorded during current or previous surveys within the project site, several other species listed as migratory under the EPBC Act are considered to have a moderate or high likelihood of occurrence, including the Fork-tailed Swift, White-bellied Sea-eagle and Rufous Fantail (refer to **Table 6.7**). Details on these species and their occurrence and habitat within the project site are provided below.

#### **Salt-water Crocodile**

**EPBC Act Status:** Migratory (marine)

**TPWC Act Status:** Not listed

#### **Species Overview**

The Salt-water Crocodile typically occurs in tidal rivers, coastal floodplains and channels, billabongs and swamps up to 150 km inland from the coast (DotE, 2013k). Preferred nesting habitat of the Salt-water Crocodile includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements (DotE, 2013k). Floating rafts of vegetation also provide important nesting habitat (DotE, 2013k). The primary food sources of the Salt-water



Crocodile include crustaceans, insects and mammals; however, only larger individuals eat mammals (DotE, 2013k). The distribution of the Salt-water Crocodile ranges from Rockhampton in Queensland, throughout coastal Northern Territory to King Sound (near Broome) in Western Australia (DotE, 2013k). In Australia, threats to the Salt-water Crocodile include mortality due to fishing nets and the effects of habitat destruction (DotE, 2013k). The Salt-water Crocodile is not, however, a threatened species. The species is managed in the Northern Territory under the Management Program for the Saltwater Crocodile in the Northern Territory of Australia (Leach *et al.*, 2009), which predominantly relates to the sustainable harvesting of the species and management of the species in urbanised areas.

### **EPBC Act Plans**

#### *i. Conservation Advice*

There is no Approved Conservation Advice for the Salt-water Crocodile.

#### *ii. Recovery Plan*

There is no Recovery Plan for the Salt-water Crocodile.

#### *iii. Threat Abatement Plan*

There are no Threat Abatement Plans in place for the Salt-water Crocodile.

### **Presence and Habitat in the Project Site**

The Salt-water Crocodile was recorded at three locations within the project site during the current study (**Figure 17**). A photograph of a Salt-water Crocodile recorded on IR camera within the project site is shown in **Photograph 6.11**. The individuals were recorded within close proximity of each other, in a tributary of the Amagula River along the southern boundary of the Southern EL. The individuals were recorded during aquatic surveys and on an IR camera. This species was recorded in vegetation community MU11 within the project site. Previous surveys within the project site have not recorded the Salt-water Crocodile.

The tributaries of the Amagula River and Emerald River provide suitable habitat for this species; however the availability of such habitat is reliant on seasonal conditions. Suitable habitat for the Salt-water Crocodile is likely to be more restricted within the dry season when there is less water within the waterways. Habitat types identified within the project site in which the species occurs include aquatic and riparian habitats. The species is unlikely to move into other habitat types. Suitable prey for this species recorded in proximity to the observed individuals include terrestrial fauna such as the Agile Wallaby (*Macropus agilis*), Northern Brown Bandicoot (*Isodon macrourus*), the Northern Quoll (*Dasyurus hallucatus*), and aquatic species such as small fish, macroinvertebrates and riparian reptiles such as water monitors.



**Photograph 6.11** Salt-water Crocodile detected by an IR camera

**Rainbow Bee-eater**

**EPBC Act Status:** Migratory (terrestrial)

**TPWC Act Status:** Not listed

***Species Overview***

The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation, often in proximity to permanent water (DotE, 2014e). This species feeds mainly on insects, such as bees and wasps, and on occasion will take earthworms, spiders and tadpoles (DotE, 2013s). Nests of this species are located in long burrows or tunnels that are excavated in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel, or in cliff-faces (DotE, 2013s). Populations that breed in northern Australia are considered to be resident, and in many northern localities the Rainbow Bee-eater is present throughout the year (DotE, 2013s). The Rainbow Bee-eater occurs across much of mainland Australia (DotE, 2013s). The only identified threat to the Rainbow Bee-eater is the introduced Cane Toad which reduces the breeding success and productivity of the Rainbow Bee-eater by feeding on eggs and especially nestlings, and usurping and occupying nesting burrows (DotE, 2013s). The Rainbow Bee-eater is not, however, a threatened species.

***EPBC Act Plans***

*i. Conservation Advice*

There is no Approved Conservation Advice for the Rainbow Bee-eater.



*ii. Recovery Plan*

There is no Recovery Plan in place for the Rainbow Bee-eater.

*iii. Threat Abatement Plan*

A Threat Abatement Plan is in place for the Rainbow Bee-eater for the threat of the European Red Fox. This plan is not relevant in the context of Groote Eylandt, given the European Red Fox is not present on the island.

***Presence and Habitat within the Project Site***

The Rainbow Bee-eater was recorded from 12 locations within the project site during the current study, through bird census surveys and incidentally (**Figure 17**). A photograph of a Rainbow Bee-eater recorded incidentally within the project site is shown in **Photograph 6.12**. This species was recorded within the Southern EL and haul road corridor, in vegetation communities MU4, MU16, MU17, MU18 and MU31. URS (2012) and Webb (1992) also recorded this species within their respective studies. Although Webb's (1992) study area included the project site, it is unclear as to whether any of the records of this species are from within the project site. Additional records of this species are held in the NRM InfoNet database (DLRM, 2014d) within the Southern EL and Northern EL.

Extensive areas of suitable foraging habitat for this species occur within the project site. The species is considered likely to forage across habitat types including open forest, sandstone woodland and rock outcrops, woodland/shrubland and riparian habitats. The species is also known to forage for invertebrates across water. It is not considered likely to occur in closed forest (rainforest) habitats. Nesting habitat for this species is present in the form of incised drainage lines and exposed banks along tracks. It is expected that this species both forages and breeds within the project site. The Rainbow Bee-eater was recorded during both survey periods for the current study, which may indicate that the local population of the species is resident.



**Photograph 6.12**      **Rainbow Bee-eater**

**Fork-tailed Swift**

**EPBC Act Status:** Migratory (marine)

**TPWC Act Status:** Not listed

***Species Overview***

The Fork-tailed Swift is known to migrate to Australia during its non-breeding season (August to March) (DotE, 2013a). This species is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher, mostly over inland plains but sometimes above foothills or in coastal areas (DotE, 2013a). Foraging occurs anywhere from 1 m to 300 m above the ground, with the known diet comprising small bees, wasps, termites and moths (DotE, 2013a). This species breeds in Siberia (DotE, 2013a). There are no significant threats to the Fork-tailed Swift in Australia (DotE, 2013a).

***EPBC Act Plans***

*i. Conservation Advice*

There is no Approved Conservation Advice for the Fork-tailed Swift.



*ii. Recovery Plan*

There is no Recovery Plan in place for the Fork-tailed Swift.

*iii. Threat Abatement Plan*

There are no Threat Abatement Plans in place for the Fork-tailed Swift.

***Presence and Habitat within the Project Site***

The Fork-tailed Swift was not recorded within the project site during the current surveys. URS (URS Australia Pty Ltd, 2012) recorded this species in an area to the west of the project site, but not within the project site boundary.

There is potential fly-over habitat for this species above the vegetation within the project site and it is expected to forage aerially about these areas on occasion. No breeding habitat is present within the project site as breeding occurs outside of Australia.

**White-bellied Sea-eagle**

**EPBC Act Status:** Migratory (terrestrial)

**TPWC Act Status:** Not listed

***Species Overview***

The White-bellied Sea-eagle inhabits coastal habitats, particularly those close to the sea-shore, and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands (DotE, 2014d). Its habitat is characterised by the presence of large areas of open water including larger rivers, swamps, lakes and the sea, and it has been recorded flying over a variety of terrestrial habitats (DotE, 2014d). This species feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal (DotE, 2014d). A large nest is built from sticks and lined with leaves, grass or seaweed and may be built in a variety of sites including tall trees (especially *Eucalyptus* species), bushes, mangroves, cliffs, rocky outcrops, caves, crevices, on the ground or even on artificial structures (DotE, 2014d). The White-bellied Sea-eagle occurs along the coastline (including offshore islands) of mainland Australia and Tasmania (DotE, 2014d). The main threats to the White-bellied Sea-eagle are the loss of habitat due to land development and the disturbance of nesting pairs by human activity (DotE, 2014d).

***EPBC Act Plans***

*i. Conservation Advice*

There is no Approved Conservation Advice for the White-bellied Sea-eagle.

*ii. Recovery Plan*

There is no Recovery Plan for the White-bellied Sea-eagle.



### iii. *Threat Abatement Plan*

A Threat Abatement Plan is in place for the White-bellied Sea-eagle for the threat of the European Red Fox. This plan is not relevant in the context of Groote Eylandt, given the European Red Fox is not present on the island.

### ***Presence and Habitat within the Project Site***

The White-bellied Sea-eagle was not recorded within the project site during the current surveys. This species was recorded by URS (2012) further west of the project site. The majority of records held within the InfoNet database on Groote Eylandt occur in coastal areas.

Potential foraging habitat for this species occurs within vegetation across the project site, particularly areas located in proximity to the Amagula River and Emerald River and their tributaries. The species is considered most likely to occur foraging within riparian and aquatic habitats, but also has the potential to forage in open forest habitats. The species may also occur in other habitat types within the project site, but these are likely to be used during transit between roosting or breeding habitat and aquatic foraging habitat. The suitability of such foraging habitat is reliant on seasonal rainfall. This species is expected to utilise the project site as part of a much larger foraging range around the coastal areas of Groote Eylandt. This species is not expected to breed within the project site, with breeding most likely to occur in coastal areas.

### ***Rufous Fantail***

**EPBC Act Status:** Migratory (terrestrial)

**TPWC Act Status:** Not listed

### ***Species Overview***

The Rufous Fantail has a movement pattern that is not well understood, however some populations in east Australia are considered migratory (DotE, 2013v). In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as *Eucalyptus microcorys* (Tallowwood), *Eucalyptus cypellocarpa* (Monkey Gum), *Eucalyptus radiata* (Narrow-leaved Peppermint), *Eucalyptus regnans* (Mountain Ash), *Eucalyptus delegatensis* (Alpine Ash), *Eucalyptus pilularis* (Blackbutt) or *Eucalyptus resinifera* (Red Mahogany), usually with a dense shrubby understorey often including ferns (DotE, 2013v). When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including *Corymbia maculata* (Spotted Gum), *Eucalyptus melliodora* (Yellow Box), ironbarks or stringybarks, often with a shrubby or heath understorey (DotE, 2013v). In north and north-east Australia, they often occur in tropical rainforest and monsoon rainforests, including semi-evergreen mesophyll vine forests, semi-deciduous vine thickets or thickets of paperbarks (DotE, 2013v). The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia (DotE, 2013v). The main threat to the Rufous Fantail is probably fragmentation and loss of core moist forest breeding habitat through land clearing and urbanisation; especially forest



remnants and corridors along the species' migration routes (DotE, 2013v). The species breeds throughout its range in Australia over summer months, and migrates altitudinally or latitudinally during winter. Individuals from south-eastern Australia migrate north to Cape York and the Torres Strait, while individuals in the Atherton region migrate to lower altitudes during winter (DotE 2013v). The Rufous Fantail is not, however, a threatened species.

### ***EPBC Act Plans***

#### *i. Conservation Advice*

There is no Approved Conservation Advice for the Rufous Fantail.

#### *ii. Recovery Plan*

There is no Recovery Plan for the Rufous Fantail.

#### *iii. Threat Abatement Plan*

There are no Threat Abatement Plans in place for the Rufous Fantail.

### ***Presence and Habitat within the Project Site***

The Rufous Fantail was not recorded within the project site during the current surveys. This species was recorded by Webb (1992) on the western side of Groote Eylandt within monsoon vine forest, however the exact location of the record is unknown.

Potential habitat for this species occurs in closed forest (rainforest) and in riparian habitats within the project site. These vegetation communities are located in the north west and southern portions of the Southern EL. This species is expected to utilise the project site as part of a much larger foraging range, and has the potential to utilise the project site as breeding habitat.

### ***6.3.3 TPWC Act Species***

Six threatened fauna species listed under the TPWC Act have been recorded within the project site, including the Masked Owl (northern), Brush-tailed Rabbit-rat, Northern Quoll, Northern Hopping-mouse, Yellow-spotted Monitor and Mertens' Water Monitor. Of these, the Masked Owl (northern), Brush-tailed Rabbit-rat, Northern Quoll, Northern Hopping-mouse are also listed as threatened under the EPBC Act and have been considered previously in **Section 6.3.1**.

Details on the occurrence and habitat of the Yellow-spotted Monitor and Mertens' Water Monitor within the project site are provided below. No other TPWC Act listed threatened fauna species are considered to have a moderate or high likelihood of occurrence within the project site and as such are not assessed further within this report.

#### **Yellow-spotted Monitor**

**EPBC Act Status:** Not listed





**TPWC Act Status:** Vulnerable

### ***Species Overview***

The Yellow-spotted Monitor occupies a variety of habitats, including coastal beaches, floodplains, grasslands and woodlands (Ward *et al.*, 2012). Clutches of eggs are typically laid in the wet season in burrows in the ground (Ward *et al.*, 2012). Recent research has indicated that these species make use of large communal burrows / warrens (Doody, *et al.*, 2014). It feeds mostly on small terrestrial vertebrates and insects, and often digs up prey, especially eggs of marine and freshwater turtles (Ward *et al.*, 2012). The Yellow-spotted Monitor has a broad geographic range across the far North of Australia from the Kimberley to Cape York Peninsula, and southwards through most of Queensland (Ward *et al.*, 2012). In the Northern Territory, it has been recorded across most of the Top End and the Gulf Region (Ward *et al.*, 2012). The advance of the Cane Toad across the Northern Territory is the most serious threat facing the Yellow-spotted Monitor as it is highly susceptible to the toxins of the Cane Toad (Ward *et al.*, 2012, Doody *et al.* 2009).

### ***Presence and Habitat within the Project Site***

The Yellow-spotted Monitor was recorded from a total of three locations within the project site using cage traps and IR cameras (**Figure 17**). A photograph of the Yellow-spotted Monitor captured during trapping surveys within the project site is shown in **Photograph 6.13**. The Yellow-spotted Monitor was also recorded from mine rehabilitation at the existing GEMCO mine (**Appendix B**). The locations within the project site all occur within the Southern EL. This species was recorded in vegetation communities MU4 and MU20 within the project site. No other records of this species occur within the project site.

Due to the range of habitat this species is known from, all of the vegetation communities within the project site are considered to form potential habitat for this species. This includes the habitat types of closed forest, open forest, sandstone woodland and rock outcrops, woodland/shrubland, riparian and seasonal wetland habitats. A variety of small terrestrial vertebrates are present within the project site, including the Delicate Mouse (*Pseudomys delicatulus*) and Common Rock-rat (*Zyzomys argurus*).



**Photograph 6.13** Yellow-spotted Monitor captured during trapping surveys

### **Mertens' Water Monitor**

**EPBC Act Status:** Not listed

**TPWC Act Status:** Vulnerable

### ***Species Overview***

Mertens' Water Monitor is semi-aquatic and is seldom seen far from water (Ward *et al.*, 2006). It is often observed climbing on rocks or trees near water, often basking on branches overhanging the water or on rocks mid-stream (Ward *et al.*, 2006). It lays eggs in a burrow constructed in the ground, with egg-laying usually in the early dry season (Ward *et al.*, 2006). It feeds mostly on fish, frogs and carrion, and is also known to eat insects and small terrestrial vertebrates (Ward *et al.*, 2006). Mertens' Water Monitor has a broad geographic range, occupying coastal and inland waters across the far north of Australia from the Kimberley to the west side of Cape York Peninsula (Ward *et al.*, 2006). In the Northern Territory it has been recorded across most of the Top End and the Gulf Region (Ward *et al.*, 2006). The advance of the Cane Toad across the Northern Territory is the most serious threat facing Mertens' Water Monitor as it is known to consume the Cane Toad and die from the ingested toxins (Ward *et al.*, 2012, Doody *et al.* 2009).

### ***Presence and Habitat within the Project Site***

Mertens' Water Monitor was recorded from a total of nine locations within the project site during the current study and at an additional location just beyond the southern boundary of



the Southern EL (**Figure 17**). A photograph of a Mertens' Water Monitor recorded on IR camera within the project site is shown in **Photograph 6.14**. The Mertens' Water Monitor was also recorded within mine rehabilitation areas at the existing GEMCO mine (**Appendix B**).

The majority of records within the project site are located within the Southern EL, with only two records in the Northern EL. This species was recorded in vegetation communities MU4, MU11 and MU20 adjacent to watercourses. URS (2012) and Webb (1992) also recorded this species within their respective studies, however none were noted as occurring within the project site.

The tributaries of Amagula River and Emerald River provide suitable habitat for this species; however the availability of such habitat is reliant on seasonal conditions. Suitable habitat for Mertens' Water Monitor is likely to be more restricted within the dry season when there is less water within the waterways. Habitat types in which this species would occur within the project site include riparian and aquatic habitats. Suitable prey for this species occurring in proximity to the recorded individuals includes Remote Froglet (*Crinia remota*) and small fish such as rainbow fish and gudgeons.



**Photograph 6.14** Mertens' Water Monitor detected by an IR camera

## Impact Assessment

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This section presents an assessment of the likely impacts of the project to the terrestrial ecology occurring within the project site. The impact assessment focuses on species listed under the EPBC Act and/or the TPWC Act that were recorded during the field surveys or considered to have a high or moderate potential to occur due to the presence of suitable habitat.

The following impacts were considered:

- Direct impacts such as the clearing of vegetation and habitat for open cut mining purposes, and for the construction of infrastructure such as haul roads (**Section 7.1**); and
- Indirect impacts such as habitat fragmentation, edge effects, the effects of noise and vibration, vehicle strikes, lighting, dust, erosion and the introduction of invasive species (**Section 7.2**).

This section considers these categories of impacts of the project separately for vegetation communities, flora species and fauna species, and includes an impact assessment for each threatened species recorded within the project site or that was considered to have a high or moderate potential to occur.

The project disturbance footprint is shown in **Figure 18**. The layout of the disturbance footprint has been designed to avoid areas of high ecological value wherever possible. Clearing activities will be subjected to a number of controls to ensure that impacts are minimised. Mitigation measures for these impacts are described in **Chapter 8**.

### 7.1 Direct Impacts

#### 7.1.1 Vegetation Clearing

The largest direct impact of the project is the removal of native vegetation communities that also provide habitat for a wide range of flora and fauna species. The total disturbance footprint (i.e. the area of direct impact) is 1,525 ha in size and includes clearing for the open cut mining area and associated infrastructure. **Table 7.1** provides a breakdown of the areas of each vegetation community to be cleared and **Figure 19** shows their distribution within the disturbance footprint. The direct clearing of vegetation within the disturbance footprint will occur gradually over the 15-year life of the project. Rehabilitation of mined areas will occur



progressively following mining and continue for a number of years following the end of the project.

The dominant vegetation community impacted by the project through clearing is MU4 - *Eucalyptus tetradonta* / *Eucalyptus miniata* open forest with low shrub or tussock grass understorey which occupies 73% of the disturbance footprint. The vegetation communities occurring within the disturbance footprint are widespread on Groote Eylandt. None of the vegetation communities recorded within the disturbance footprint form threatened ecological communities listed under the EPBC Act and/or TPWC Act.

**Table 7.1 Vegetation Communities within the Disturbance Area**

Map Unit	Vegetation Community	EPBC Act Status	TPWC Act Status	Disturbance Footprint (ha) <sup>1</sup>
MU3	Dry sub-coastal (inland) monsoon vine forest	-	-	0.0
MU4	<i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> open forest with low shrub or tussock grass understorey	-	-	1,119.4
MU5	<i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> / <i>Callitris intratropica</i> open-forest with mixed shrub/ tussock grass understorey			0.0
MU10a	<i>Melaleuca viridiflora</i> / <i>Corymbia polycarpa</i> open forest with <i>Pandanus spiralis</i> and mixed tussock grassland understorey	-	-	79.0
MU10b	MU10b - <i>Melaleuca viridiflora</i> open-forest and mixed tussock grassland understorey	-	-	9.8
MU11	<i>Melaleuca leucadendra</i> / <i>Dillenia alata</i> open forest with fern/ sedge understorey	-	-	0.0
MU15a	<i>Melaleuca cajuputi</i> low closed-forest / <i>Leptocarpus</i> sedgeland/ closed sedgeland (permanent swamps / sedgelands)	-	-	7.1
MU16	<i>Eucalyptus tetradonta</i> low open forest / woodland with low tree or <i>Sorghum interjectum</i> tussock grassland understorey	-	-	181.1
MU17	<i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> / <i>Eucalyptus polycarpa</i> woodland with low shrub or tussock / hummock grass understorey	-	-	84.2
MU18	<i>Callitris intratropica</i> / <i>Eucalyptus tetradonta</i> / <i>Eucalyptus kombolgiensis</i> woodland to open woodland with hummock grassland understorey	-	-	5.9
MU20	<i>Melaleuca viridiflora</i> / <i>Eucalyptus polycarpa</i> / <i>Grevillea pteridifolia</i> woodland with <i>Asteromyrtus symphyocarpa</i> and <i>Vetiveria elongata</i> tussock grassland	-	-	5.0

Map Unit	Vegetation Community	EPBC Act Status	TPWC Act Status	Disturbance Footprint (ha) <sup>1</sup>
MU24	<i>Eucalyptus tetradonta</i> / <i>Eucalyptus polycarpa</i> / <i>Melaleuca viridiflora</i> low open-woodland with <i>Asteromyrtus symphyocarpa</i> shrubland	-	-	9.0
MU31	<i>Eucalyptus tectifera</i> open woodland with mixed shrub / tussock grass understorey	-	-	24.8
<b>TOTAL</b>				<b>1,525</b>

<sup>1</sup> In some cases totals may not equal the appropriate total number due to rounding.

### 7.1.2 Habitat Clearing

The native vegetation throughout the project site provides habitat for a range of flora and fauna, including some species that are listed as threatened or migratory under the EPBC Act and/or TPWC Act. The vegetation communities within the project site support a range of habitat types for flora and fauna species, and specific habitat features provide foraging, shelter and breeding opportunities for fauna. The project will remove areas of various habitats within the project site, including a suite of specific habitat features. The broad habitat types and habitat features to be removed are discussed in the following sections.

Despite the project resulting in the removal of areas of habitat, extensive areas of land containing similar habitat occurs both within the project site and in nearby areas. It is anticipated that the types of flora and fauna species utilising the habitat within the disturbance footprint will continue to persist in these adjacent areas where suitable habitat is present.

Additionally, rehabilitation of mined areas is proposed to occur progressively over the life of the project. The objective of the rehabilitation is to recreate and establish a self-sustaining post-mining landscape that resembles the original vegetation communities and is able to support a diverse range of viable flora and fauna populations. GEMCO has extensive experience and success with mine rehabilitation. A study of the fauna species present within rehabilitated areas of the existing GEMCO mine was undertaken as a part of this assessment, and is presented in **Appendix B**. A previous survey of select fauna taxa (birds and ants) in GEMCO mine rehabilitation was undertaken by URS in 2012 (URS Australia Pty Ltd, 2012). These surveys of mine rehabilitation have demonstrated that vertebrate fauna is progressively colonising rehabilitated areas at the existing GEMCO mine. The study undertaken as part of the EIS (**Appendix B**) also found several threatened species within the mine rehabilitation areas.

The project site will be rehabilitated in accordance with GEMCO's existing rehabilitation standards and consequently it is anticipated that, over time, rehabilitated areas will provide habitat for a range of flora and fauna species. Progressive rehabilitation will serve to reduce the duration of the impact associated with habitat clearing, ensuring that (for most species) it is not a permanent impact.



The direct clearing of habitat within the disturbance footprint will occur gradually over the 15-year life of the project. The habitats within the project site are well connected with similar habitats within the locality, and consequently the staging of impacts will allow for the relocation of many fauna species into these adjacent areas. New habitat for a suite of fauna species will be created through the progressive rehabilitation of mined areas.

Seven broad habitat types have been identified on Groote Eylandt including closed forest, open forest, sandstone woodland, coastal complex/dunes, riparian zones, active mining and mine rehabilitation and lakes/lagoons. A breakdown of the clearance of these broad habitat types within the disturbance footprint is provided in **Table 7.2** and **Figure 20** shows their distribution within the disturbance footprint.

The most impacted broad habitat type is open forest (1,514 ha), however it represents only 1.3% of the open forest habitat present on Groote Eylandt. A range of habitat features are present within each of the broad habitats within the disturbance footprint and are discussed further below.

**Table 7.2 Broad Habitat Types to be Cleared within the Disturbance Footprint**

Broad Habitat Type	Disturbance Footprint (ha) <sup>1</sup>	Groote Eylandt (ha) <sup>1</sup>	% of Habitat Type to be Cleared
Closed Forest	0.0	6,145.3	0.0
Open Forest (including woodland / shrubland habitats and seasonal wetlands)	1,514.4	118,071.2	1.3
Sandstone Woodland	5.9	55,195.9	0.0
Coastal complex/dunes	0.0	41,959.5	0.0
Riparian Zone	5.0	4,180.8	0.1
Active Mining and Mine Rehabilitation	0.0	3,310.1	0.0
Lakes/Lagoons	0.0	2,317.3	0.0
<b>Total</b>	<b>1,525</b>	<b>231,180</b>	<b>0.7</b>

<sup>1</sup> In some cases totals may not equal the appropriate total number due to rounding.

*i. Habitat Features*

The project will include the removal of specific habitat features within the disturbance footprint. Important fauna habitat features that would be removed by the project include:

- Understorey vegetation – shelter and foraging habitat for amphibians, reptiles, small birds and terrestrial mammals;
- Fallen logs, debris and leaf litter – shelter habitat for amphibians, reptiles and terrestrial mammals;



- Rocky outcrops – shelter and breeding habitat for amphibians, reptiles and terrestrial mammals;
- Hollow-bearing living trees and stags – shelter and breeding habitat for a range of reptiles, birds, arboreal mammals and microbats;
- Nectar-producing trees and shrubs – foraging habitat for insects, blossom-dependent birds, arboreal mammals and megachiropteran bats;
- Feed trees, shrubs and grasses for a range of species – food for small birds, cockatoos and herbivorous mammals; and
- Seasonal wetlands –habitat for amphibians and waterbirds.

## 7.2 Indirect Impacts

The project will have a range of indirect impacts on the ecological values of remaining vegetation and habitat within the project site, including fragmentation and edge effects. Additionally, there are a number of potential indirect impacts arising from the construction and operations activities. These include increased dust, noise, light and potentially erosion. There is the potential for these indirect effects to impact the remaining vegetation and habitat. Indirect impacts relevant to the project are considered in more detail below.

Indirect impacts have been considered within the Assessments of Significance within **Appendix J**.

### 7.2.1 *Habitat Fragmentation*

One of the potential impacts of the project on flora and fauna is habitat fragmentation. Fragmentation is the process where habitats that were once continuous become divided into separate fragments isolated from each other by non-forest land (Primack, 1993; Fahrig, 2003; Lindenmayer and Fischer, 2006). The resultant divided habitat is often artificial and inhospitable to the species remaining within the fragments (Bennet, 1990; Reid, 1999) (Bennett A.F, 1990, Reid, 1999).

Habitat fragmentation affects biodiversity by reducing the amount of available habitat for some species as it involves some habitat loss. Plants and other sessile organisms are usually directly removed, while mobile animals (especially birds and mammals) retreat into other remnant patches of habitat (Lindenmayer and Fischer, 2006). Indirectly, fragmentation can place stress on native flora and fauna by increasing intraspecific and interspecific competition for space and resources in areas of remaining habitat.

Barrier effects are another impact of habitat fragmentation. This occurs where particular species are either unable, or are unwilling, to move between suitable areas of fragmented habitat. Species that are most vulnerable to barrier effects include rare species, smaller ground-dwelling species and species with low mobility. Species that are least vulnerable to barrier effects tend to be those that are large or highly mobile (e.g. birds and bats), as they can move between fragments (Bennet, 1990).





The project is likely to increase fragmentation through the clearing of areas of open forest and woodland. Mobile native fauna species such as birds and bats have the potential to move across disturbed habitats, however less mobile species, or species with small home ranges, such as small terrestrial mammals, would be further impacted. Only one discrete patch of habitat, comprising open forest, will be temporarily isolated by mining within the Northern EL (**Figure 18** and **Figure 20**). This patch is located in the Northern EL, where an area of vegetation will be surrounded on all sides by quarries and/or haul roads. In all other areas the vegetation will continue to be connected to larger areas of undisturbed vegetation.

Relatively narrow corridors of habitat will also be created by the project along some riparian areas, however these corridors will continue to be connected to remaining undisturbed habitat within the project site. The vegetation surrounding the mine will largely be contiguous and movement and dispersal opportunities will remain.

### **7.2.2 Edge Effects**

A consequence of habitat fragmentation is that it produces “edge effects”. Edge effects are impacts that occur at the interface between natural habitats (especially forests) and disturbed or developed land (Yahner, 1988). When an edge is created between woodland and a cleared area, changes to ecological processes within the vegetation can extend between 10 m and 100 m from the edge (Yahner, 1988). These include microclimatic changes in light, temperature, humidity and wind, which can favour a suite of different species and therefore cause significant changes to the ecology of the patch (Lindenmayer and Fischer, 2006) (Lindenmayer, 2006). These changes can include invasion by weeds, increase in feral animals, reduction in tree health, and barriers to dispersal or distribution (Yahner, 1988).

The project will result in edge effects where vegetation is cleared to make way for mining or infrastructure. Due to edge effects, the indirect impacts of the mine may extend beyond the areas that are being cleared and into the areas of adjacent habitat that fringe the mine disturbance footprint. Edge effects cannot be quantified until after project activities have commenced.

### **7.2.3 Noise and Vibration**

The project will generate noise during the construction and operations phases. Noise and vibration will be generated from various sources such as mining trucks, excavators, bulldozers and explosives.

Some fauna species are sensitive to elevated levels of noise in their environment and this has the potential to impact negatively on these species (AMEC Americas Limited, 2005). Noise can affect animal physiology and behaviour, and if it becomes an ongoing stress, it can be injurious to an animal's energy budget, reproductive success and long-term survival. There are other potential effects that include habitat loss through avoidance, reduced reproductive success and a retreat away from favourable habitats (AMEC, 2005).

Noise also affects the way that animal-created sounds are heard and interpreted by other animals. This can include mating calls, territorial calls and alarm calls. Interference with



these calls by noise created by the mine, has the potential to disrupt the species relying on these calls with deleterious results including reduced reproductive success and mortality (AMEC, 2005).

The noise created by the construction and operation of the mine is likely to affect native species and affect the value of the habitats that remain. Some species are likely to move in response to noise, and therefore the habitat value of the woodlands remaining in the immediate vicinity of mining and infrastructure areas may decrease. This has the effect of increasing the amount of habitat for native species that will be disturbed as a result of the project. However, it is likely that most animal species will habituate to noise disturbance (AMEC, 2005), and the project is likely to only cause temporary disturbance to fauna. Furthermore, the impacts from noise emissions are likely to be localised close to the operational quarries and haul roads (up to 100 m) and are not likely to have a significant, long-term, impact on wildlife populations. It should also be noted that the project will be mined on a campaign basis, and there may be no mining for extended periods in any one year. This means that the impact from noise occurs periodically, rather than continuously.

Noise will diminish within areas that are progressively rehabilitated and, in the long term, noise levels will return to normal following rehabilitation of the total mined area and cessation of mining.

#### **7.2.4 Vehicle Strike**

Vehicle strike can pose a significant risk to some wildlife, particularly but not exclusively ground dwelling species (Taylor and Goldingay, 2010). The project will result in the construction of haul roads and the associated numbers of mine vehicles traversing these roads can impact animals that may cross and navigate these roads. Impacts from vehicle strike are likely to occur due to haul trucks and other mine vehicles operating within the mining area, or travelling between the project site and the existing GEMCO mine.

Although some mortality of animals as a result of vehicle strike is likely, it is not expected to be significant. Speed limits along internal roads, appropriate signage and GEMCO's own enforced driving policies will increase the awareness of drivers and decrease the risk of vehicles striking fauna. The risk of vehicle strike will diminish following rehabilitation of the total mined area and cessation of mining.

#### **7.2.5 Light**

In general, increased light levels may adversely impact wildlife by direct glare, chronic or periodic increased illumination and temporary unexpected fluctuations in light levels (Saleh, 2007; Longcore and Rich, 2010). Research into impacts from altered lighting (Longcore and Rich, 2004) indicates that it can trigger behavioural and physiological responses that include but are not limited to:

- Changes in foraging behaviour, such as when diurnal species begin foraging during night-time;



- A disruption of seasonal day length cues which trigger critical behaviours (Longcore and Rich, 2004; Saleh, 2007; Longcore and Rich, 2010);
- Disorientation and/or temporary blindness; and
- Interference with predator-prey relationships.

Although increased light levels can impact wildlife, there are very limited sources of light proposed within the project site. Sources of light are restricted to vehicle headlights, lighting of the crib huts (small demountable buildings), as well as lighting of areas being mined at night. The lighting of mining areas is temporary, with lights only used in the particular quarry being mined at night. At any one time, only a small proportion of the project site would experience any impacts from lighting. The impacts from night light pollution are likely to remain close to the light sources, with only limited glare into the surrounding natural vegetation. It is likely that most fauna species would habituate to the levels of light pollution or temporarily move away from areas of night lighting and return once the night lighting has ceased. Light is therefore unlikely to have a significant or long-term impact on any fauna species.

Light levels will return to normal following rehabilitation of the total mined area and cessation of mining.

### **7.2.6 Dust**

Construction and mining activities have the ability to generate dust, which may impact on the ecology within the project site in a number of ways. Dust that settles can accumulate on leaf surfaces and reduce essential physiological processes including photosynthesis, respiration, and transpiration (Farmer, 1993). Dust can also produce physical effects on plants such as blockage and damage to stomata, shading, and abrasion of leaf surfaces or cuticles. Decreased growth and vigour of plants may mean that they are more susceptible to pathogens and other disturbance, and these plants are more likely to be subject to increased mortality. Such impacts to individual plants generally result in decreased productivity and can result in changes in vegetation and community structure (Farmer, 1993).

The effect of dust deposition also affects animals that use plants, either as a source of food or habitat. Dust on the foliage and fruit may reduce palatability to animals, and decreased health of trees and changed community structure results in a reduction in the amount of available habitat.

Dust pollution can lead to a decrease in habitat quality which has the potential to extend the area of impact beyond the area directly disturbed by the mine. Increased levels of dust could impact vegetation within woodland communities, reducing health of some species along the edge of mined areas and roads. It could also impact upon potential foraging resources for wildlife. That notwithstanding, dust will diminish within areas that are progressively rehabilitated and, in the long term, dust levels should return to normal following rehabilitation of the total mined area and cessation of mining. Dust is less likely to be an issue in the wet season, than in the dry season. Standard dust minimisation strategies such as watering haul roads will be implemented to minimise the creation of dust, particularly



during the dry season. In the context of the scale of the project, dust is not considered likely to cause a significant impact on the ecological values of the project site.

For the purposes of this investigation, a specific dust investigation was conducted to establish whether there was evidence that dust was having an impact on native vegetation adjacent to the existing GEMCO mine, particularly vegetation adjacent to an existing haul road (see **Appendix K**). The study found that dust was deposited mainly on vegetation on the western side of the mine/haul road, due to the prevailing winds being from the north east and north west. While bands of dust are clearly discernible on the canopy of forest vegetation as seen from aerial photographs taken during the dry season, the vegetation survey found no evidence that dust is having a significant detrimental impact upon native vegetation. This is shown by:

- No evidence of crown dieback, or dieback of any of the open forest strata;
- No floristic difference between vegetation samples taken from areas exposed to dust and vegetation in control sites in relatively dust-free areas; and
- No evidence of additional weed species in areas where dust is prevalent.

In areas where dust is prevalent due to mining on Groote Eylandt, two factors are likely to naturally mitigate dust impacts on vegetation and fauna habitat: rain and fires. Heavy rains during the wet season wash dust from foliage and settle the dust raised from activities along haul roads and quarries. Fire removes old and dusty foliage and triggers renewed foliage growth, providing new surfaces for photosynthesis, and improves food for herbivores.

Given these factors, and the experience at the existing GEMCO mine, it is considered unlikely that dust impacts will significantly affect the terrestrial ecology of the project site or adjacent areas.

### **7.2.7 Erosion and Sedimentation**

The project has the potential to increase the amount of erosion occurring in the project site through the construction of the open cut mine, roads, tracks, and infrastructure, and due to vegetation clearance associated within these activities. The project site is located in a tropical climate, and during the wet season heavy rainfall can erode and wash away any disturbed earth relatively easily. This has the potential to increase sedimentation and turbidity of watercourses.

The EIS Aquatic Ecology Report explains that the project has been designed to ensure that there will be no mining activities within the main channel of watercourses or within the 1% Annual Exceedance Probability (1 in 100 year) flood extents of the watercourses. This design principle will significantly reduce the potential for the project to give rise to erosion and sedimentation impacts on watercourses.

Active mining areas and recently rehabilitated areas may be subject to erosion, potentially leading to runoff with elevated levels of suspended sediment. An Erosion and Sediment Control Plan (ESCP) will be developed prior to commencement of construction to address



erosion and the control of suspended sediment in drainage from these areas. Runoff from disturbed areas will be captured in collection drains and directed through sediment traps and sediment dams for control of suspended sediment prior to discharge from site. Sediment collected in sediment dams will be excavated at regular intervals and disposed of in the overburden emplacement areas. Diversion drains will be installed to divert overland flow from upstream areas around disturbed areas. All works will be designed and constructed in accordance with an ESCP. Monitoring will be undertaken to confirm the success of these measures and identify any necessary remedial actions.

It is considered that, with the implementation of appropriate measures, as described above, it is unlikely that erosion or sedimentation will significantly affect the aquatic ecology of the project site or downstream areas.

### **7.2.8 Feral Animals and Weeds**

Alterations to habitat conditions often favour introduced and/or hardy native plant and animal species that can proliferate in disturbed conditions. Such species have potential to impact upon the original local native plant and animal species.

GEMCO has a quarantine procedure that provides guidance on how to correctly inspect barges and their cargo such as shipping containers, vehicles and equipment coming to Groote Eylandt as well as the port facilities at Milner Bay for quarantine purposes. It is intended to prevent unwanted pests and weeds arriving on Groote Eylandt.

Feral animals can cause problems for native fauna species by preying upon them or by competing with them for food and resources. Currently the only feral animals recorded in the project site are the Domestic Dog/Dingo (*Canis familiaris/lupus*) and Feral Cat (*Cattus cattus*). The project has the potential to increase the numbers of these animals due to the creation of transport vectors for feral animal such as tracks and haul roads.

The Cane Toad (*Rhinella marina*) is currently absent from Groote Eylandt. In addition to the quarantine procedure, GEMCO also has a specific Cane Toad Management Plan which is in operation across all GEMCO leases and across the island, should a Cane Toad be found. This plan will continue to operate and will be applicable for the Eastern Leases. However, the project is unlikely to exacerbate the risk of the introduction of this species to the island beyond current conditions, given that it will not significantly increase transport vectors for the Cane Toad. There will be no increase in barges or flights during the operations phase of the project, given that the project will not increase the operations workforce or production rate. The only increase in freight requirements will be during the construction phases of the project, but the construction phases are brief (each lasting less than 18 months) and freight transport will be subject to GEMCO's existing quarantine procedures.

Weeds have the potential to out-compete native plant species for resources such as nutrients, sunlight and space. Weeds are most likely to occur at disturbed locations where they can be readily spread. The invasion of weeds within native vegetation can alter the diversity and functioning of vegetation communities.



URS (2012) found that within GEMCO's existing mining tenement, the diversity of invasive species increased between baseline surveys conducted in 1992 (Webb, 1992) and the 2012 baseline surveys. Weed diversity was highest in the rehabilitation areas due to increased opportunities for weed colonisation. However, the URS (2012) study also found that undisturbed areas of GEMCO existing mineral leases still contained moderately high levels of weed diversity, possibly due to their proximity to disturbed areas. The 2012 baseline surveys conducted by URS (2012) also indicated that two declared Class B and C weed species, *Stachytarpheta cayennensis* (Snakeweed) and *Hyptis suaveolens* (Hyptis) are known to occur within the rehabilitation areas and another five declared Class B and C weeds are known to occur elsewhere in the tenement.

Although the project site is currently unaffected by weed species, there is a high potential for weeds to become established as project activities take place. Weed species known to occur in the existing tenements, particularly commonly recorded species such as *Hyptis suaveolens*, *Passiflora foetida* (Stinking Passionflower), *Urochloa mosambicensis* (Sabi Grass) and *Stylosanthes* spp. (the Stylos) (Addison, 2013), are likely to have the highest potential to establish in the project site.

GEMCO will implement weed and feral animal control measures for the project site (**Chapter 8**). This will include the implementation of appropriate control measures including monitoring and population reduction. With the implementation of these measures, it is unlikely that feral animals or weeds will have a large impact on the ecology of the project site.

## 7.3 Impacts to Threatened Ecological Communities

### 7.3.1 EPBC Act Communities

None of the vegetation communities occurring within the project site are listed as a TEC under the EPBC Act and no TECs are considered to occur within the surrounding areas. As such, no impacts to EPBC Act listed communities are anticipated.

### 7.3.2 TPWC Act Communities

The TPWC Act contains no listings for threatened ecological communities, and none of the vegetation communities occurring within the project site are listed under the TPWC Act.

## 7.4 Impacts to Significant Ecological Communities

Significant ecological communities include old growth forest, riparian forest and woodland, swamp woodland, and monsoon rainforest.

The major form of old growth forest that will be impacted by the proposed development will be MU4 (*Eucalyptus tetradonta/Eucalyptus miniata* open forest with low shrub grass or tussock understorey). Approximately 1,119.4 ha of this forest type will be cleared, removing large numbers of older trees that have hollows. Notwithstanding this, the total forest area to be cleared is relatively small when compared to areas that will remain unmined on the island. Also, it is proposed to rehabilitate and replant areas in the future and monitoring of existing



rehabilitation on the island by GEMCO has demonstrated that both *E. tetradonta* and *E. miniata* and other trees and shrubs from this community can and have been regrown on mined areas. For this reason, in the long term, it is predicted that tree hollow resources will be returned to the mined areas.

With regard to riparian forest and woodland, swamp woodland and monsoon rainforest, these vegetation types within the project site are essentially forms of groundwater dependent ecosystems, and so the impacts to such vegetation are described in the section below.

## 7.5 Impacts to Groundwater Dependent Ecosystems

As described in **Section 5.3**, the distribution and form of a number of vegetation types (MU10a (*Melaleuca viridiflora/Corymbia polycarpa* open forest), MU16 *E. tetradonta* low open forest and woodland and MU31 (*Eucalyptus tectifica* open woodland) appears to be influenced by the presence of shallow groundwater. The groundwater table in the laterite aquifer was assessed as closely following the surface topography with groundwater flows occurring towards the major creeks and rivers. Further detail on the groundwater regime and potential impacts on groundwater is provided in the EIS Groundwater Report.

The EIS Groundwater Report has predicted that open cut mining will reduce water pressures in parts of the laterite aquifer. Depressurisation of the aquifer will lead to a decrease in the elevation of the water table in this aquifer. The area in which water pressures will be reduced is referred to as the zone of depressurisation, and the maximum predicted extent of depressurisation is less than 1 km from the proposed quarries and reduces with distance from the quarries. Post mining groundwater levels in the laterite aquifer are predicted to recover rapidly following completion of mining. 80% of the drawdown is predicted to recover within 5 years of mining. Almost total recovery of groundwater levels (i.e. to pre-mining levels) is expected to be achieved within 20 years of mine closure. This rapid groundwater recovery is due to the high rate of recharge to the laterite aquifer. The EIS Groundwater Report contains further detail on this predicted impact, including figures showing predicted groundwater drawdown contours.

Groundwater drawdown has the potential to indirectly impact upon vegetation, increasing the depth of groundwater to a point where some groundwater dependent vegetation starts to change. However, drawdown will occur predominantly within the quarries, where vegetation will be cleared ahead of mining (as discussed in **Section 7.1**). Although groundwater drawdown is predicted to occur in some areas beyond the quarries, drawdown effects are predicted to be temporary and are consequently unlikely to have a significant, residual effect on vegetation. It is also noteworthy that there is no evidence that such indirect impacts have occurred to significantly impact vegetation composition around the existing mine on Groote Eylandt, despite more than 50 years of mining in an area with shallow groundwater. For these reasons, no significant impacts on vegetation are predicted as a result of groundwater drawdown.

In addition to the vegetation communities discussed above, tall swamp forest with rainforest elements (MU11 *Melaleuca leucadendra/Dillenia alata* open forest - see **Figure 15**) grows along the perennial sections of the watercourses in the project site. Theoretically there is a



potential to reduce the flows of groundwater that sustain these perennial reaches of the watercourses, which could give rise to a detrimental impact on the vegetation that occurs in these areas. However, the EIS Groundwater Report has determined that no significant changes to flows in the watercourses are predicted as a result of mining and so no significant impacts to terrestrial flora and fauna are predicted as a result.

The small, highly localised rainforest patch (MU3 Dry sub-coastal monsoon rainforest - see **Figure 15**) that occurs in the southern portion of the southern Eastern Lease will not be cleared. A localised lens of shallow groundwater is likely to be present beneath MU3. The shallow groundwater lens will be located above the water table of the laterite aquifer. These water bodies are effectively disconnected and not in hydraulic continuity. Localised depressurisation predicted in the laterite around the proposed quarries does not extend to the footprint of the MU3. Furthermore, due to the disconnection between the laterite aquifer and the groundwater lens beneath the MU3 there is no mechanism by which drawdown of the lateritic water table would be likely to propagate upwards to any shallow overlying groundwater lens. Consequently, the localised patch of rainforest (MU3) is unlikely to experience any significant detrimental impacts from the project.

## 7.6 Impacts to Threatened Flora Species

### 7.6.1 EPBC Act Species

No threatened flora species listed under the EPBC Act have been encountered within the project site and none are predicted to occur. No threatened flora species are considered likely to occur within the project site. As such, no impacts to EPBC Act listed flora species are anticipated.

### 7.6.2 TPWC Act Species

No threatened flora species listed under the TPWC Act have been encountered within the project site. The Northern Territory NRM InfoNet database holds records for one threatened flora species on Groote Eylandt - *Hernandia nymphaeifolia* (Lantern Tree) which is listed as Vulnerable under the TPWC Act and was last recorded in 1988. This species is considered to have a low likelihood of occurrence (see **Appendix F**) as it is a coastal species and suitable habitat does not occur in the project site.

No threatened flora species are considered likely to occur within the project site. As such, no impacts to TPWC Act listed flora species are anticipated.

## 7.7 Impacts to Threatened Fauna Species

A number of threatened fauna species listed under the EPBC Act and/or TPWC Act have been recorded within the project site. Several additional threatened species have the potential to occur, given the proximity of recent database records and the presence of suitable habitat for these species. The potential impacts to the threatened species recorded,





or those species assessed with a high to moderate likelihood of being present on the project site, is provided below.

### **7.7.1 EPBC Act Species (Threatened)**

Four threatened fauna species listed under the EPBC Act have been recorded within the project site, including the Masked Owl (northern), Brush-tailed Rabbit-rat, Northern Quoll and Northern Hopping-mouse. Impacts to each of these species are discussed below. An assessment of the significance of impacts to each of these species has been undertaken according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) and are provided in **Appendix J**.

#### *i. Masked Owl (northern)*

**EPBC Act Status:** Vulnerable

**TPWC Act Status:** Vulnerable

**Occurrence within project site:** Confirmed

The Masked Owl (northern) has been recorded within the project site and it is anticipated that this species would utilise the available habitat for foraging and breeding. Key habitats that will be removed by the project include open forest, sandstone woodland and rock outcrops and closed forest (rainforest) which contain hollow-bearing trees and a high density of small- to medium-sized mammals. Foraging habitat in the form of woodland/ shrubland will also be impacted. Previous surveys within the Eastern Leases identified potential hollows for this species within *Eucalyptus tetradonta* (Darwin Stringybark), *Eucalyptus miniata* (Darwin Woollybutt) and dead standing trees (EMS, 2013; EMS, 2014b). Although the Masked Owl (northern) requires medium- to large-sized hollows, which are not present in all areas, a high proportion of the vegetation communities to be removed within the project site comprise these tree types.

The project may also result in indirect impacts to this species, through habitat fragmentation, edge effects and alteration of light and noise levels. Many of these indirect impacts may have consequences on the foraging resources for the Masked Owl (northern), as small- to medium-sized ground-dwelling mammals may alter habitat usage in response to these impacts. However, species such as the Northern Brown Bandicoot (*Isodon macrourus*) and the Northern Quoll (*Dasyurus hallucatus*) are known to occur in areas adjacent to mining or main roads (see **Appendix B**).

The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site. Some individuals may be tolerant to some disturbance in their habitat as the species is highly mobile and is expected to occupy a range of areas on Groote Eylandt at various times. Despite the clearing of 1,525 ha of vegetation within the project site, the habitat present is not considered important for the long-term survival of the species within the locality. Areas of potential habitat will be retained within the project site, with extensive areas of potential habitat occurring immediately adjacent. Mined areas will be progressively rehabilitated to



woodland and open forest habitats. Over time, such areas would provide suitable foraging habitat for the Masked Owl (northern). Prey items for this species are known to occur within the rehabilitated areas in the existing GEMCO mine (see **Appendix B**). In the longer term, habitat features such as trees containing hollows of a suitable size for this species would develop.

An assessment of significance has been conducted for this species according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for vulnerable species (see **Appendix J**). This assessment indicates that no significant impact is predicted on the Masked Owl as a result of the project.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to the Masked Owl (northern), and these measures are consistent with the recovery plan that is in place for this species. In particular, the recovery plan notes the threats posed by the introduction of feral animals and weeds, and altered fire regimes. The proponent will implement a program of feral animal and weed control within the project site. It will also develop and implement a fire regime on the project site to optimise biodiversity values. The proponent will work with Traditional Owners in relation to land management, particularly fire management.

There is no approved conservation advice or threat abatement plans in place for the Masked Owl (Northern).

ii. *Brush-tailed Rabbit-rat*

**EPBC Act Status:** Vulnerable

**TPWC Act Status:** Endangered

**Occurrence within project site:** Confirmed

The Brush-tailed Rabbit-rat has been recorded from the project site and it is anticipated that this species would utilise the available habitat for foraging and breeding. Key habitats that will be removed by the project include open forest habitats of *Eucalyptus tetradonta* and *Eucalyptus miniata* with a sparse shrub layer and grassy understorey in areas that are not frequently burnt. Additionally, habitat types such as closed forest (rainforest), sandstone woodland and rock outcrops, and riparian habitats would also be removed. Sheltering habitat comprising tree hollows, fallen hollow logs and Pandanus will also be removed within the project site.

The project may also result in indirect impacts to this species, through habitat fragmentation, edge effects and alteration of light and noise levels. Many of these indirect impacts may alter habitat usage by the Brush-tailed Rabbit-rat.

The records of the Brush-tailed Rabbit-rat within the project site are located in close proximity to the disturbance footprint. The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this



species within the project site. Despite the clearing of 1,525 ha of vegetation within the project site, the Brush-tailed Rabbit-rat is considered likely to persist within the project site, as significant areas (thousands of hectares) of similar habitat for the species will be retained within the project site and across the island. Only a small percentage of such habitat will be removed (less than 1%). Further to this, mined areas are to be progressively rehabilitated to woodland and open forest habitats. Over time, such areas have the potential to provide habitat for the Brush-tailed Rabbit-rat; however this species has not previously been recorded within mine rehabilitation areas to date.

An assessment of significance has been conducted for this species according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for vulnerable species (see **Appendix J**). This assessment indicates that a significant impact is predicted on the Brush-tailed Rabbit-rat as a result of the project. Offsets are proposed to be provided to compensate for this impact. **Chapter 8** describes the proposed offsets, as well as impact avoidance and mitigation measures.

The impact avoidance and mitigation measures that have been developed for the project (Chapter 8) are consistent with the approved conservation advice and threat abatement plan (for the threat of feral cats) for this species. In particular, the approved conservation advice notes the threats posed by the introduction of invasive weeds, predation by cats (also addressed in the threat abatement plan), and altered fire regimes. The proponent will implement a program of weed management, and feral cat control within the project site. It will also develop and implement a fire regime on the project site to optimise biodiversity values. The proponent will work with Traditional Owners (via the ALC) in relation to land management, particularly fire management. The approved conservation advice for the Brush-tailed Rabbit-rat specifically notes the importance of the ALC as a key player in the conservation of this species, given the ALC's role in land management on Groote Eylandt.

In addition, offsets are proposed to be provided for this species, given that habitat loss associated with the project has the potential to give rise to a significant, residual impact to the Brush-tailed Rabbit-rat. The proposed offsets will address priority actions outlined in the approved conservation advice, and also address feral cat control. Offsets are discussed further in the EIS Biodiversity Offsets Strategy.

There is no recovery plan in place for the Brush-tailed Rabbit-rat.

### *iii. Northern Quoll*

**EPBC Act Status:** Endangered

**TPWC Act Status:** Critically Endangered

**Occurrence within project site:** Confirmed

The Northern Quoll has been recorded extensively within the project site and it is anticipated that this species would forage and breed within the project site. Key habitats that will be removed by the project include vegetation communities with high structural diversity located in proximity to rocky habitats such as sandstone woodland and rock outcrops and open



forest. Other features that will be removed within the disturbance footprint include tree hollows, hollow logs and termite mounds, which are found in closed forest (rainforest), woodland/shrubland and riparian habitats.

The project may also result in indirect impacts to this species, through habitat fragmentation, edge effects and alteration of light and noise levels. However, the Northern Quoll is known to occur in areas adjacent to mining or main roads (see **Appendix B**) and it is assumed to have a relatively high tolerance of impacts such as light and noise.

The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site. Some individuals may be tolerant to some disturbance in their habitat. Despite the clearing of 1,525 ha of vegetation within the project site, the habitat present is not considered important for the long-term survival of the species within the locality due to the distribution and abundance of the species on Groote Eylandt. Areas of potential habitat will be retained within the project site, with extensive areas of potential habitat occurring immediately adjacent. Mined areas are to be progressively rehabilitated to woodland and open forest habitats. Over time, such areas would provide suitable habitat for the Northern Quoll, which is known to occur within mine rehabilitated areas in the existing GEMCO mine (see **Appendix B**). Staged rehabilitation and the occupation of the habitat provided within these areas will assist in the persistence of the species within the project site.

The potential impacts of the project on the Northern Quoll were assessed against the EPBC referral guidelines for this species (SEWPAC, 2011). These guidelines assist proponents in determining whether an action will potentially have a significant impact on the Northern Quoll. An assessment of significance has been conducted for this species according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r), and taking into account the EPBC Act referral guidelines for this species (see **Appendix J**). This assessment indicates that no significant impact is predicted on the Northern Quoll as a result of the project.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to the Northern Quoll, and these measures are consistent with the recovery plan that is in place for this species. In particular, the recovery plan notes the threat posed by the Cane Toad. The proponent has specific quarantine measures in place to prevent the introduction of Cane Toads on Groote Eylandt. These measures will also apply to the project. As an additional management measure for the project, the proponent will undertake an annual audit of quarantine procedures to confirm their adequacy and make recommendations for their continuous improvement. The audits would be undertaken by trained and experienced quarantine officers. The recovery plan also describes the threats posed by the introduction of feral animals and weeds, and altered fire regimes. The proponent will implement a program of feral animal and weed control within the project site. It will also develop and implement a fire regime on the project site to optimise biodiversity values. The proponent will work with Traditional Owners in relation to land management, particularly fire management.



A Threat Abatement Plan is in place for the Northern Quoll for the threat of the European Red Fox, however this plan is not relevant in the context of Groote Eylandt, given the European Red Fox is not present on the island.

There is no approved conservation advice in place for the Northern Quoll.

*iv. Northern Hopping-mouse*

**EPBC Act Status:** Vulnerable

**TPWC Act Status:** Vulnerable

**Occurrence within project site:** Confirmed

The Northern Hopping-mouse has been recorded within the project site and it is anticipated that this species would forage and breed within the project site. Key habitats that will be removed by the project include open forests with a grassy understorey which are considered to provide suitable habitat for the Northern Hopping-mouse, in particular areas with a sandy substrate and in proximity to white rock. A nominal area of sandstone woodland and rock outcrop will be impacted by the project.

The project may also result in indirect impacts to this species, through habitat fragmentation, edge effects and alteration of light and noise levels. Many of these indirect impacts may alter habitat usage by the Northern Hopping-mouse.

The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site. Despite the clearing of 1,525 ha of vegetation within the project site, the Northern Hopping-mouse is considered likely to persist within the project site, as the disturbance footprint represents only a part of its habitat within the project site. In addition, the Northern Hopping-mouse is likely to occupy only part of the disturbance footprint. The species is considered to be restricted to open forest and sandstone woodland and rock outcrop habitats, as the remainder of habitat types within the project contain soils and hydrology unsuitable for the creation of burrows. Significant areas of these habitat types will remain both within the project site and across the island.

Mined areas are to be progressively rehabilitated to woodland and open forest habitats. Over time, such areas have the potential to provide some habitat for the Northern Hopping-mouse. However, this species has specific habitat requirements (i.e. deeper sandy soils) and these requirements would need to be taken into account as part of rehabilitation planning, if the rehabilitation is to provide a suitable habitat for the Northern Hopping-mouse. This species has not been recorded within mine rehabilitation areas to date.

An assessment of significance has been conducted for this species according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for vulnerable species (see **Appendix J**). This assessment indicates that a significant impact is predicted on the Northern Hopping-mouse as a result of the project. Offsets are proposed to be provided to



compensate for this impact. **Chapter 8** describes the proposed offsets, as well as impact avoidance and mitigation measures.

The impact avoidance and mitigation measures that have been developed for the project (**Chapter 8**) are consistent with the recovery plan for this species. In particular, the recovery plan notes the threats posed by the introduction of invasive weeds, predation by cats, and altered fire regimes. The proponent will implement a program of weed management, and feral cat control within the project site. It will also develop and implement a fire regime on the project site to optimise biodiversity values. The proponent will work with Traditional Owners (via the ALC) in relation to land management, particularly fire management. The recovery plan for the Northern Hopping-mouse specifically notes the importance of Traditional Owners in the conservation of this species. The recovery plan also indicates that further research on this species is required, particularly in relation to its low trappability using conventional techniques. GEMCO is currently sponsoring a PhD study on the Northern Hopping-mouse, focussing on trapping techniques for the species.

In addition, offsets are proposed to be provided for this species, given that habitat loss associated with the project has the potential to give rise to a significant, residual impact to the Northern Hopping-mouse. The proposed offsets will address priority actions outlined in the recovery plan, and also address feral cat control. Offsets are discussed further in the EIS Biodiversity Offsets Strategy.

There is no approved conservation advice or recovery plan in place for the Northern Hopping-mouse.

### **7.7.2 EPBC Act Species (Migratory)**

Two migratory fauna species listed under the EPBC Act have been recorded within the project site, including the Salt-water Crocodile and Rainbow Bee-eater. Although not recorded during current or previous surveys within the project site, several other species listed as migratory under the EPBC Act are considered to have a moderate or high likelihood of occurrence, including the Fork-tailed Swift, White-bellied Sea-eagle and Rufous Fantail.

Potential habitat occurs in the project site for these species which may be used periodically. Impacts to each of these species are discussed below. An assessment of the significance of impacts to each of these species has been undertaken according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) and are provided in **Appendix J**.

The project site is not considered to comprise important habitat for any of the migratory species. Areas of similar habitat occur elsewhere in the locality that will remain and will continue to provide high quality habitat for these species. There is no evidence to suggest that the project site supports an ecologically significant proportion of the population of these migratory species and no breeding was observed during field surveys.

#### *i. Salt-water Crocodile*

**EPBC Act Status:** Migratory (marine)



**TPWC Act Status:** Not listed

**Occurrence within project site:** Confirmed

The Salt-water Crocodile has been recorded within the project site and it is anticipated that this species would utilise the available habitat for foraging and breeding. Habitat that will be removed within the project site include small areas of riparian habitat containing ephemeral water resources and suitable prey items within such areas. The suitability of such habitat for the Salt-water Crocodile is reliant on seasonal conditions. The project may also result in indirect impacts to this species, particularly through habitat fragmentation and edge effects. Additionally, the alteration of movement corridors and hydrological regimes has the potential to impact this species.

Design principles were adopted to ensure that mine planning was cognisant of environmental sensitivities such as this, and a range of impact avoidance measures were developed. This included buffers around the defined drainage channels of the Emerald River, Amagula River and their tributaries. The mine plan and quarry extents were then designed to ensure alignment with the buffers, and to restrict mining to areas beyond the defined drainage channels and associated buffers.

Although the loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site, the species is considered likely to persist within the project site, as known habitat will be retained within the project site, and areas of potential habitat occur immediately adjacent. Records of this species within the project site are located outside of the disturbance footprint. The habitat present is not considered important for the long-term survival of the species within the locality due to the distribution and abundance of the species on Groote Eylandt.

An assessment of significance has been conducted for this species according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for migratory species (see **Appendix J**). This assessment indicates that the project is unlikely to have a significant impact on the Salt-water Crocodile.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to the Salt-water Crocodile.

There is no approved conservation advice, threat abatement plans, or recovery plan in place for the Salt-water Crocodile.

ii. *Rainbow Bee-eater*

**EPBC Act Status:** Migratory (terrestrial)

**TPWC Act Status:** Not listed

**Occurrence within project site:** Confirmed



The Rainbow Bee-eater has been recorded at numerous locations within the project site and it is anticipated that this species would utilise the available habitat for foraging and breeding. Key habitats that will be removed by the project include open forests, woodlands/shrublands, sandstone woodland and rock outcrops, and riparian habitats, particularly in close proximity to water. Breeding habitat for this species will also be removed in the form of incised drainage lines and exposed banks along tracks.

The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site. Some individuals may be tolerant to some disturbance in their habitat as the species is highly mobile and is expected to occupy a range of areas on Groote Eylandt at various times. Despite the clearing of 1,525 ha of vegetation within the project site, the habitat present is not considered important for the long-term survival of the species within the locality. Areas of potential habitat will be retained within the project site, with extensive areas of potential habitat occurring immediately adjacent. Mined areas are to be progressively rehabilitated to woodland and open forest habitats. Over time, such areas would provide suitable habitat for the Rainbow Bee-eater, which is known to occur within mine rehabilitated areas in the existing GEMCO mine (see **Appendix B**). Staged rehabilitation and the occupation of the habitat provided within these areas will assist in the persistence of the species within the project site.

An assessment of significance has been conducted for this species according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for migratory species (see **Appendix J**). This assessment indicates that the project is unlikely to have a significant impact on the Rainbow Bee-eater.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to the Rainbow Bee-eater.

A Threat Abatement Plan is in place for the Rainbow Bee-eater for the threat of the European Red Fox, however this plan is not relevant in the context of Groote Eylandt, given the European Red Fox is not present on the island. There is no approved conservation advice or recovery plan in place for the Rainbow Bee-eater.

*iii. Fork-tailed Swift*

**EPBC Act Status:** Migratory (marine)

**TPWC Act Status:** Not listed

**Likely Occurrence within project site:** Moderate

The migratory (marine) species Fork-tailed Swift is an aerial feeding bird that is likely to occasionally forage over the majority of the project site. This species is an extremely wide-ranging bird that accesses resources from across a large area and it is unlikely to be dependent on the resources present above the project site for its survival. No breeding habitat will be impacted as this species does not breed in Australia (DotE, 2013a). Mined





areas are to be progressively rehabilitated to woodland and open forest habitats consistent with the pre-mining landuse. Over time, such areas would provide suitable flyover habitat for the Fork-tailed Swift.

An assessment of significance has been conducted for the Fork-tailed Swift according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for migratory species (see **Appendix J**). This assessment indicates that the project is unlikely to have a significant impact on this species.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to the Fork-tailed Swift.

There is no approved conservation advice, threat abatement plans, or recovery plan in place for the Fork-tailed Swift.

*iv. White-bellied Sea-eagle and Rufous Fantail*

**EPBC Act Status:** Migratory (terrestrial)

**TPWC Act Status:** Not listed

**Likely Occurrence within project site:** Moderate

The migratory (terrestrial) species White-bellied Sea-eagle and Rufous Fantail are aquatic and forest species that would likely utilise niche habitats within the project site. The project will remove foraging habitat for both these species, and potential breeding habitat for the Rufous Fantail. Potential habitat cleared for the White-bellied Sea-eagle occurs as tall riparian vegetation, open forest and woodland located in proximity to rivers and their tributaries where water is present. The White-bellied Sea-eagle is expected to utilise the project site as part of a much larger foraging range around the coastal areas of Groote Eylandt. Potential habitat cleared for the Rufous Fantail includes riparian vegetation and closed forest (rainforest).

An assessment of significance has been conducted for the White-bellied Sea-eagle and Rufous Fantail according to the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DotE, 2013r) for migratory species (see **Appendix J**). This assessment indicates that the project is unlikely to have a significant impact on these species.

A range of impact avoidance and mitigation, as well as compensatory measures have been developed for the project and these are presented in **Chapter 8** and **Chapter 9**, respectively. A number of these measures are relevant to the Rufous Fantail and White-bellied Sea-eagle.

A Threat Abatement Plan is in place for the White-bellied Sea-eagle for the threat of the European Red Fox, however this plan is not relevant in the context of Groote Eylandt, given the European Red Fox is not present on the island. There is no approved conservation advice or recovery plan in place for the White-bellied Sea-eagle.



There is no approved conservation advice, threat abatement plans, or recovery plan in place for the Rufous Fantail.

### **7.7.3 TPWC Act Fauna Species**

Six threatened fauna species listed under the TPWC Act have been recorded within the project site, including the Masked Owl (northern), Brush-tailed Rabbit-rat, Northern Quoll, Northern Hopping-mouse, Yellow-spotted Monitor and Mertens' Water Monitor. Of these, the Masked Owl (northern), Brush-tailed Rabbit-rat, Northern Quoll, Northern Hopping-mouse are also listed as threatened under the EPBC Act and have been considered previously in **Section 7.7.1**. Impacts to the Yellow-spotted Monitor and Mertens' Water Monitor are discussed below.

#### *i. Yellow-spotted Monitor*

**EPBC Act Status:** Not listed

**TPWC Act Status:** Vulnerable

**Occurrence within project site:** Confirmed

The Yellow-spotted Monitor has been recorded within the project site and it is anticipated that this species would forage and breed within the project site. Key habitats that will be removed by the project include open forest and woodland, with suitable prey items such as small terrestrial vertebrates and insects. As the species is wide ranging, it has the potential to occur in all habitat types within the project site. The project may also result in indirect impacts to this species, through habitat fragmentation, edge effects and alteration of light and noise levels. However, the Yellow-spotted Monitor is known to occur in areas adjacent to main roads (see **Appendix B**) and is assumed to have a relatively high tolerance of impacts such as light and noise.

The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site. Some individuals may be tolerant to some disturbance in their habitat. Despite the clearing of 1,525 ha of vegetation within the project site, the habitat present is not considered important for the long-term survival of the species within the locality. Areas of potential habitat will be retained within the project site, with extensive areas of potential habitat occurring immediately adjacent. Mined areas are to be progressively rehabilitated to woodland and open forest habitats. Over time, such areas would provide suitable habitat for the Yellow-spotted Monitor, which is known to occur within mine rehabilitation areas in the existing GEMCO mine (see **Appendix B**). Staged rehabilitation and the occupation of the habitat provided within these areas will assist in the persistence of the species within the project site.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to the Yellow-spotted Monitor.



ii. *Mertens' Water Monitor*

**EPBC Act Status:** Not listed

**TPWC Act Status:** Vulnerable

**Occurrence within project site:** Confirmed

Mertens' Water Monitor has been recorded within the project site and it is anticipated that this species would forage and breed within the project site. Key habitats that will be removed by the project include vegetated and rocky riparian areas with suitable prey items such as fish, frogs, carrion, insects and small terrestrial vertebrates. The suitability of such habitat is reliant on seasonal conditions. The project has the potential to result in indirect impacts to this species, particularly through habitat fragmentation and edge effects.

Design principles were adopted to ensure that mine planning was cognisant of environmental sensitivities such as this, and a range of impact avoidance measures were developed. This included buffers around the defined drainage channels of the Emerald River, Amagula River and their tributaries. The mine plan and quarry extents were then designed to ensure alignment with the buffers, and to restrict mining to areas beyond the defined drainage channels and associated buffers.

The loss and modification of foraging and breeding habitat would result in a net decrease in the amount of suitable habitat available to this species within the project site. Despite the clearing of suitable habitat within the project site, many areas of known and suitable habitat will be retained within the project site, with areas of potential habitat occurring immediately adjacent. Many of the records of this species within the project site are located outside of the disturbance footprint.

A range of impact avoidance and mitigation measures have been developed for the project and these are presented in **Chapter 8**. A number of these measures are relevant to Mertens' Water Monitor.

## 7.8 Duration and Timing of Impacts

The duration and timing of the impacts of the project has important effects on the magnitude of the overall impacts on the ecology of the project site. According to current planning, construction in the Northern EL would commence in 2017 and mining activities would commence in 2018. Construction in the Southern EL is scheduled to commence approximately four years later in 2022 and mining would then take place in both of the tenements until approximately 2031.

The total or net impacts of the project will not occur simultaneously as the mining will be staged and rehabilitation will be progressive. Open forests and woodlands will be progressively cleared by the project; however, these areas will be progressively rehabilitated with the primary aim of restoring them to the previously occurring woodland communities. The EIS Mine Rehabilitation and Closure Section provides further detail on proposed mine



rehabilitation for the project. As with the mine rehabilitation within the existing GEMCO mine, all of the mined areas will be revegetated to open forest and woodland using local provenance species. An ongoing rehabilitation monitoring program will be undertaken to confirm the success of rehabilitation and prescribe any necessary remedial work.

This means that for much of the life of the mine, the majority of the project site will be vegetated, although rehabilitated mine areas will have immature vegetation. These young rehabilitated areas will still represent habitat for some fauna species, including woodland birds, and play an important role in maintaining habitat areas as the project progresses. Thus the net loss of vegetation at a given stage of the project will be minimised through the progressive clearance and progressive rehabilitation of the land within the project site.

## 7.9 Impacts of Climate Change

There is potential for climate change to cause changes in habitat, as changed climatic conditions will favour some kinds of environments over others. This will lead to changes in the distribution of habitat which will in turn affect the distribution of native species. Areas most at risk are the wet tropics in Queensland and the alpine areas that will change significantly if temperatures rise according to predictions (Manusell Australia 2008, Williams et al 2012).

Climate change may happen too quickly for some species to adapt and may exacerbate existing threats such as land clearance, farming and pollution. Species with biological traits that make them susceptible to change, or with restricted habitats, are particularly vulnerable to extinction, as they will have nowhere to go if their habitats are rendered unsuitable.

The project will result in the reduction of habitat for native species, which may indirectly exacerbate any reduction in habitat caused by climate change. As well as reducing the extent of some communities and habitats, climate change can also facilitate the expansion of other habitats, and some species will increase their distribution as a result. There are large areas of similar habitat in the locality that is similar to the habitat present in the project site, and it is not expected that the reduction of habitat as a result of the project would significantly exacerbate the effects of climate change in the locality.

# Impact Mitigation

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## 8.1 Introduction

The purpose of this chapter is to outline the avoidance and mitigation measures proposed to ameliorate the impacts of the project on terrestrial flora and fauna. As demonstrated in previous chapters, the project site is biodiverse and provides habitat for a wide range of flora and fauna, including threatened fauna species listed under the EPBC Act and/or the TPWC Act, and potential habitat for several more fauna species. As discussed in **Chapter 7**, the project will impact the threatened species through the clearing of this habitat and a range of indirect impacts.

The impact reduction measures for the project include the following hierarchy of principles:

- Avoid - to the extent possible, the project has been designed to avoid or minimize ecological impacts;
- Mitigate - where certain impacts are unavoidable through design changes, mitigation measures have been introduced to ameliorate the ecological impacts of the Project; and
- Compensate – to provide compensation where any residual impacts remain after all mitigation measures have been adopted.

**Section 8.2** summarises the avoidance measures incorporated into the design of the project. **Section 8.3** outlines the detailed suite of mitigation measures that will be implemented to reduce the impact of the project on terrestrial flora and fauna. **Section 8.4** describes biodiversity offsets that are proposed.

## 8.2 Measures to Avoid Impacts

Open cut mining projects cannot readily avoid impacts to biodiversity where mineral resources are beneath flora and fauna habitats. However, avoidance of impacts has been achieved to the extent possible by modification of the design and location of the open cut mine and associated infrastructure away from natural habitats, where feasible.

An intensive project planning process was undertaken that included identifying areas of high quality habitat and undertaking mine planning in a manner that avoided these habitats where possible. In particular, the project has been designed to ensure that mining will not encroach



on any of the watercourses described in this report (and shown on Figure 10). In particular, buffers have been defined around the defined main channels of the Emerald River, Amagula River and their tributaries. The buffers were delineated by the 1% AEP (1 in 100 year) flood extents. The mine plan and quarry extents were then designed to ensure alignment with the buffers, and restrict mining to areas beyond the defined drainage channels and associated buffers. The mine plan and disturbance footprint shown in this report reflect these buffers. This AEP was selected to avoid disturbance of the main channels of the watercourses and ensure that there would be no interference with surface water flows. The EIS Surface Water Section provides further detail on this issue.

Avoidance of the major tributaries will protect the Emerald and Amagula Rivers from direct and downstream impacts, protecting species that depend upon these habitats. Buffers around watercourses were included as an integral part of the mine plan entirely for the purpose of avoiding environmental impacts, particularly impacts on biodiversity and surface water. Alternative mining and engineering approaches, such as diverting the watercourses, or constructing levees to allow mining directly adjacent to the main channels of the watercourses, were not pursued because of a desire to minimise the environmental impacts of the project. Further detail on the assessment of alternatives is provided in the EIS Project Description (in the main volume of the EIS).

Rocky hillsides will not be disturbed as part of the project, given their cultural sensitivity and the nature of the project site geology. Retention of all of the rocky hillsides on site protects rock outcrops that provide refugia for a suite of flora and fauna.

The haul road alignment has similarly been selected and designed based on a rigorous risk-based assessment process. The alignment was selected in order to avoid areas of known environmental sensitivity and to minimise the disturbance footprint of the haul road.

### **8.3 Measures to Mitigate Impacts**

GEMCO has a range of policies, plans and procedures for the existing mine that are relevant to flora and fauna. These policies, plans and procedures are listed in Section 8.4. They will be reviewed and revised prior to the commencement of the project to ensure that they address all activities proposed to be undertaken on the project site, and the management measures described in the remainder of this section.

#### **8.3.1 Pre-Clearing Work**

Clearing will be undertaken in accordance with the proponent's Permit to Clear process. As described below, this process includes specifications designed to limit the impact of the clearing activity itself. In addition to these specifications, the clearing process will be considered as an integral part of long term mine planning to allow clearing to be appropriately planned and staged. Undertaking the clearing progressively in a staged manner will:

- Maximise the potential for mobile species to move to adjacent areas;



- Provide an opportunity for the collection of seeds for use in rehabilitation. Seeds will be collected and stored in accordance with existing procedures; and
- Allow for a pre-clearing survey to be undertaken to identify any noxious weeds in the area so that clearing can be undertaken in a manner that avoids the spread of weeds as far as possible.

### **8.3.2 Clearing**

The following procedures will be implemented as part of the proponent's Permit to Clear process (which includes a procedure and an associated form):

- The limits of clearing will be delineated prior to the commencement of any clearing and marked clearly on plans and on the ground;
- Clearing will be confined to the smallest practicable area required to safely perform the task;
- Clearing work will be planned in a manner that causes minimum disturbance to natural drainage patterns;
- Vegetation removal will be carried out using appropriate earthmoving equipment; and
- Disturbance of the topsoil will be kept to a minimum.

### **8.3.3 Rehabilitation**

A high standard of mine rehabilitation is a key mitigation measure for the project. GEMCO has extensive experience and success with mine rehabilitation, and has an established program of monitoring of the rehabilitation. Rehabilitation is designed to restore mined land to a self-sustaining open woodland, similar to the pre-mining environment and the surrounding undisturbed land.

All areas disturbed by open cut mining activities will be progressively rehabilitated. A project-specific plan will be prepared to guide the staged rehabilitation of land within the disturbance footprint, as the mine progresses and areas become available for rehabilitation.

Rehabilitation procedures are described in the EIS Mine Rehabilitation and Closure Section. As described in this section, there are specific procedures for all the activities undertaken as part of mine rehabilitation, including topsoil management; topsoil ripping; seed collection; aerial seeding; and sowing of seed.

Rehabilitated areas will be monitored as part of the proponent's rehabilitation monitoring program. The success of rehabilitation works will be assessed against the completion criteria that have been developed by the proponent. These criteria will be reviewed for use in project rehabilitation. Completion criteria for the project will include criteria in relation to fauna colonisation.



Further detail on proposed mine rehabilitation is provided in the EIS Mine Rehabilitation and Closure Section.

### **8.3.4 Land Management**

The entire project site, including the sections that will not be disturbed as part of the project, will be managed to conserve its conservation value. Land management measures for the project site will include weed and feral animal control (including feral cat control), and fire management. Fire management will include developing and implementing a fire regime on the project site to optimise biodiversity values, whilst also ensuring the risks to human safety and property are managed. The proponent will continue to work with the Traditional Owners in relation to land management, particularly with respect to fire management.

The proponent has an existing Land and Biodiversity Management Plan (**Table 8.2**), which provides an overall framework for land management and managing potential impacts to land and biodiversity. This plan will be updated to include the construction and operation of the project, and will include the measures described above.

The workforce will also be provided with information about threatened species, as part of their induction or through general environmental awareness programs.

### **8.3.5 Indirect Impacts**

**Table 8.1** provides a summary of management measures that will be adopted in relation to indirect impacts. In some instances these measures are described in further detail in other sections of the EIS, and section references are provided.

**Table 8.1 Management of Indirect Impacts**

<b>Indirect Impact</b>	<b>Management</b>
Vehicle Strike	The project will be subject to internal procedures in relation to speed limits, safe driving practices and the installation of signage.
Light	There is very limited project lighting. However, any lighting will be designed to ensure that lighting is directed away from habitat areas, as far as possible.
Dust	The EIS Air Quality Section describes management measures, particularly watering of haul roads and progressive rehabilitation of disturbed areas.
Erosion and Sedimentation	An Erosion and Sedimentation Control Plan will be developed. It is described in the EIS Environmental Management Plan.





Indirect Impact	Management
Weeds and Feral Animals	<p>The proponent has an existing procedures in relation to weed management, which will be reviewed and applied to project activities, and to the overall management of the project site. The revised manual will include measures for the control of existing weeds (which are very limited on the project site at present) and measures to prevent the introduction of weeds. Current mine procedures include weed mapping and spraying, and vehicle washdown procedures to prevent the spread of weeds. These procedures will be applied to the project. Given the low density of weeds within the project site, specific measures will be adopted to prevent the spread of weeds from the existing mine to the project site.</p> <p>The proponent also has a Cane Toad Management Plan and an associated quarantine procedure. The management plan includes monitoring, and reporting and disposal procedures in the event of a Cane Toad being found. This plan will be reviewed and revised to ensure that it is applicable to all project activities. The proponent undertakes Cane Toad inspections as part of a quarantine control function. However, the quarantine programs are not subject to a regular audit. As an additional management measure for this project, the proponent will undertake an annual audit of quarantine procedures to confirm their adequacy and make recommendations for their continuous improvement. The audits would be undertaken by trained and experienced quarantine officers.</p> <p>The proponent will extend its procedures to include feral animal control within the project site, specifically feral cat trapping.</p>

## 8.4 Plans and Procedures

GEMCO has a number of plans relevant to the mitigation of impacts to terrestrial flora and fauna values. These plans will be reviewed and revised prior to the commencement of the project to include the management measures described in Section 8.3. The plans are as follows:

- Land and Biodiversity Management Plan. This plan will be updated to provide an overarching framework for managing the potential impact to land and biodiversity resulting from the project. It will document vegetation clearing procedures to be adopted for the project (including pre-clearing procedures and the Permit to Clear process) and land management practices on the project site (including weed and feral animal control, and fire management).
- Threatened Species Management Plan. This plan will be updated to provide guidance on minimising impacts on threatened species. It will provide a summary of existing information about threatened species, including their actual and potential occurrences, habitat and significant vegetation types. It will prescribe management measures for these species (e.g. feral animal management, fire management, rehabilitation procedures). It will address all threatened species



recorded within the project site or assessed as having a high or moderate potential to occur.

- Quarantine Inspection Procedure. This procedure provides guidance on the quarantine inspection of barges and their cargo such as shipping containers, vehicles and equipment coming to Groote Eylandt as well as the port facilities at Milner Bay. It is intended to prevent unwanted pests and weeds arriving on Groote Eylandt.
- Cane Toad Management Plan. The Cane Toad Management Plan establishes a framework to prevent the migration of cane toads to Groote Eylandt. It provides a risk analysis of the various pathways by which cane toads might arrive on Groote Eylandt and it details operational controls to minimise the risk of unwanted migration, including procedures for early detection and an action plan in case of incursion. It was created as a result of GEMCO's recognition that a cane toad invasion is Groote Eylandt's and GEMCO's most significant environmental risk.

## 8.5 Biodiversity Offsets

In accordance with the Commonwealth Environmental Offsets Policy (SEWPaC, 2012a), biodiversity offsets are required to offset any significant, residual impacts. Significant, residual impacts are considered possible for the following species (refer **Appendix J**) and offsets are proposed to be provided for the impact on these species:

- Northern Hopping-mouse; and
- Brush-tailed Rabbit-rat.

An EIS Biodiversity Offset Strategy has been prepared and is included as a separate appendix to the EIS. The strategy has been prepared to meet all of the requirements outlined in the Commonwealth Environmental Offsets Policy. A summary of the Biodiversity Offset Strategy is provided in the EIS Terrestrial Ecology Section.

## Figures

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This chapter contains the following figures:

- Figure 1: Project Location;
- Figure 2: Project Layout;
- Figure 3: Bioregion Setting;
- Figure 4: Location of URS (2012) and Webb (1992) Flora and Fauna Survey Area;
- Figure 5: Flora Survey Locations;
- Figure 6: Fauna Survey Locations;
- Figure 7: Surface Geology;
- Figure 8: Soils Mapping;
- Figure 9: Land Systems Mapping;
- Figure 10: Hydrology;
- Figure 11: Broad Habitat Types across Groote Eylandt;
- Figure 12: Previous NT NRM InfoNet Database Records of Threatened Flora on Groote Eylandt;
- Figure 13: Previous NT NRM InfoNet Database Records of Threatened Fauna on Groote Eylandt;
- Figure 14: Previous NT NRM InfoNet Database Records of Migratory Fauna on Groote Eylandt;
- Figure 15: Vegetation Communities within the Project Site;
- Figure 16: Habitat Types within the Project Site;
- Figure 17: Threatened Fauna Records within the Project Site;
- Figure 18: Disturbance Footprint;



- Figure 19: Vegetation Communities within the Disturbance Footprint (also refer to Figure 15); and
- Figure 20: Broad Habitat Types within the Disturbance Footprint



Figure 1. Project Location

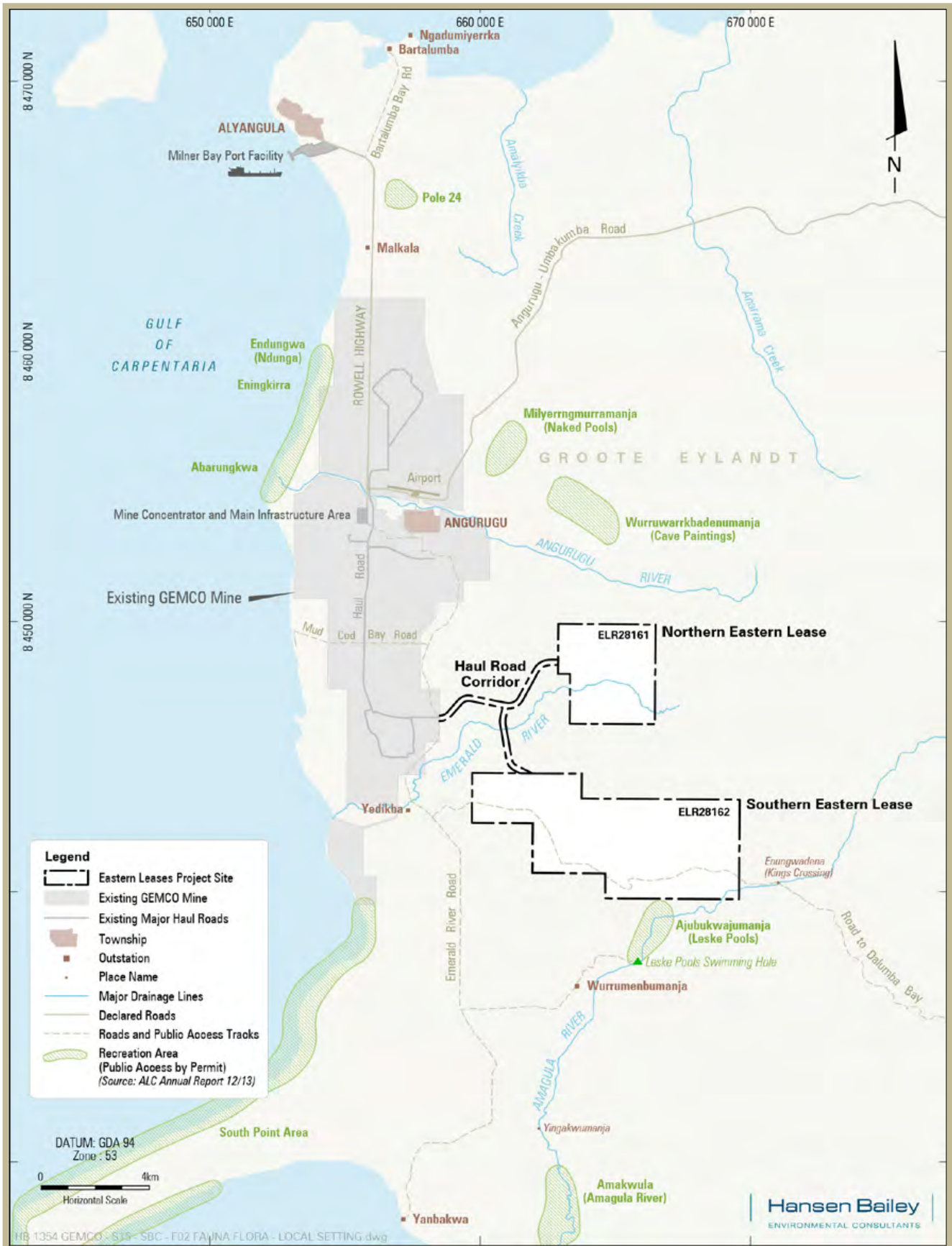


Figure 2. Project Layout



Figure 3. Bioregion Setting

Coordinate System: MGA Zone 53 (GDA 94)



Figure 4. Location of URS (2012) and Webb (1992) Flora and Fauna Survey Area



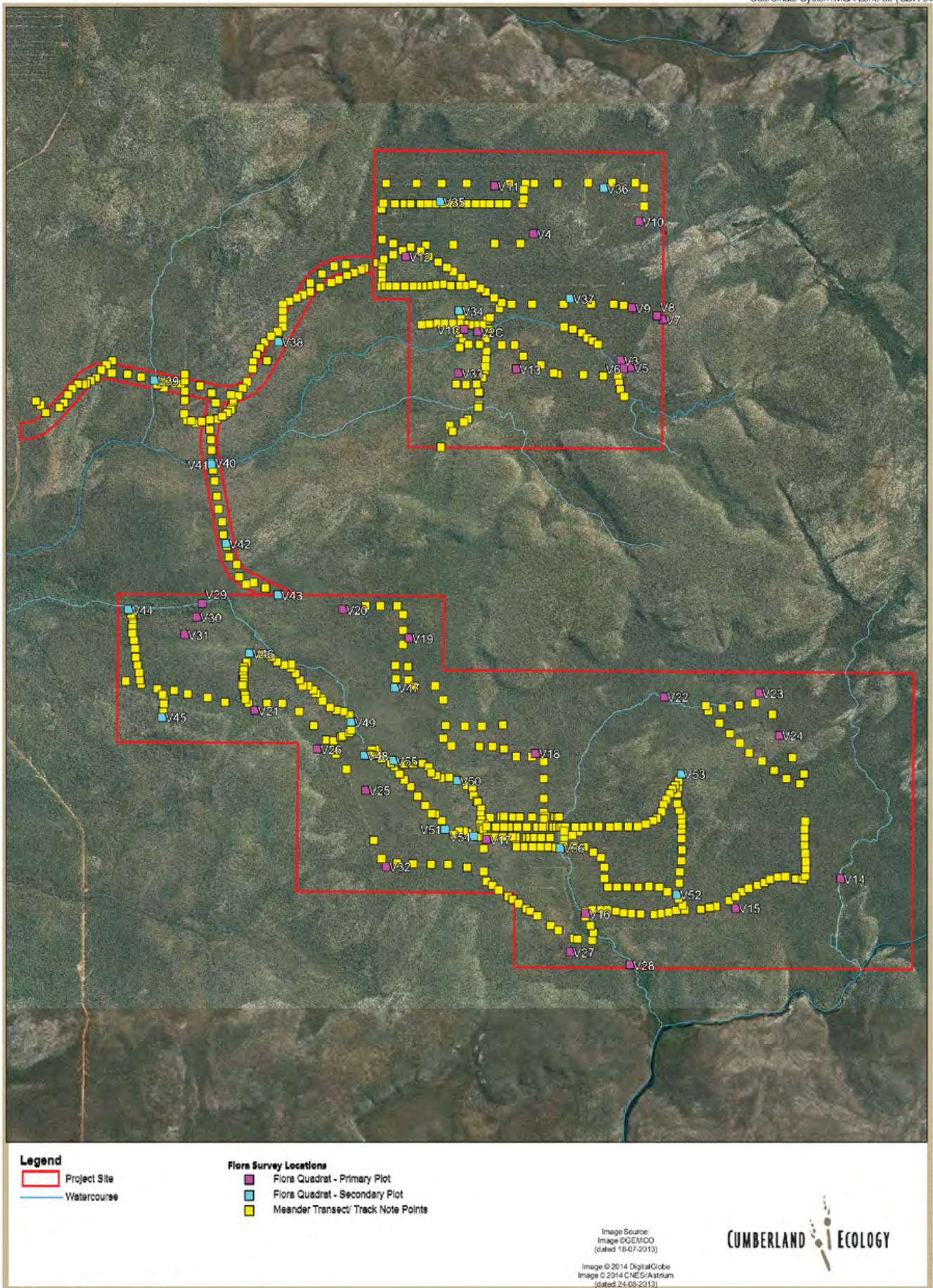


Figure 5. Flora Survey Locations

I:\...IQ14\021\Figures\RP\20141217\Figure 5

Coordinate System: MGA Zone 53 (GDA 94)

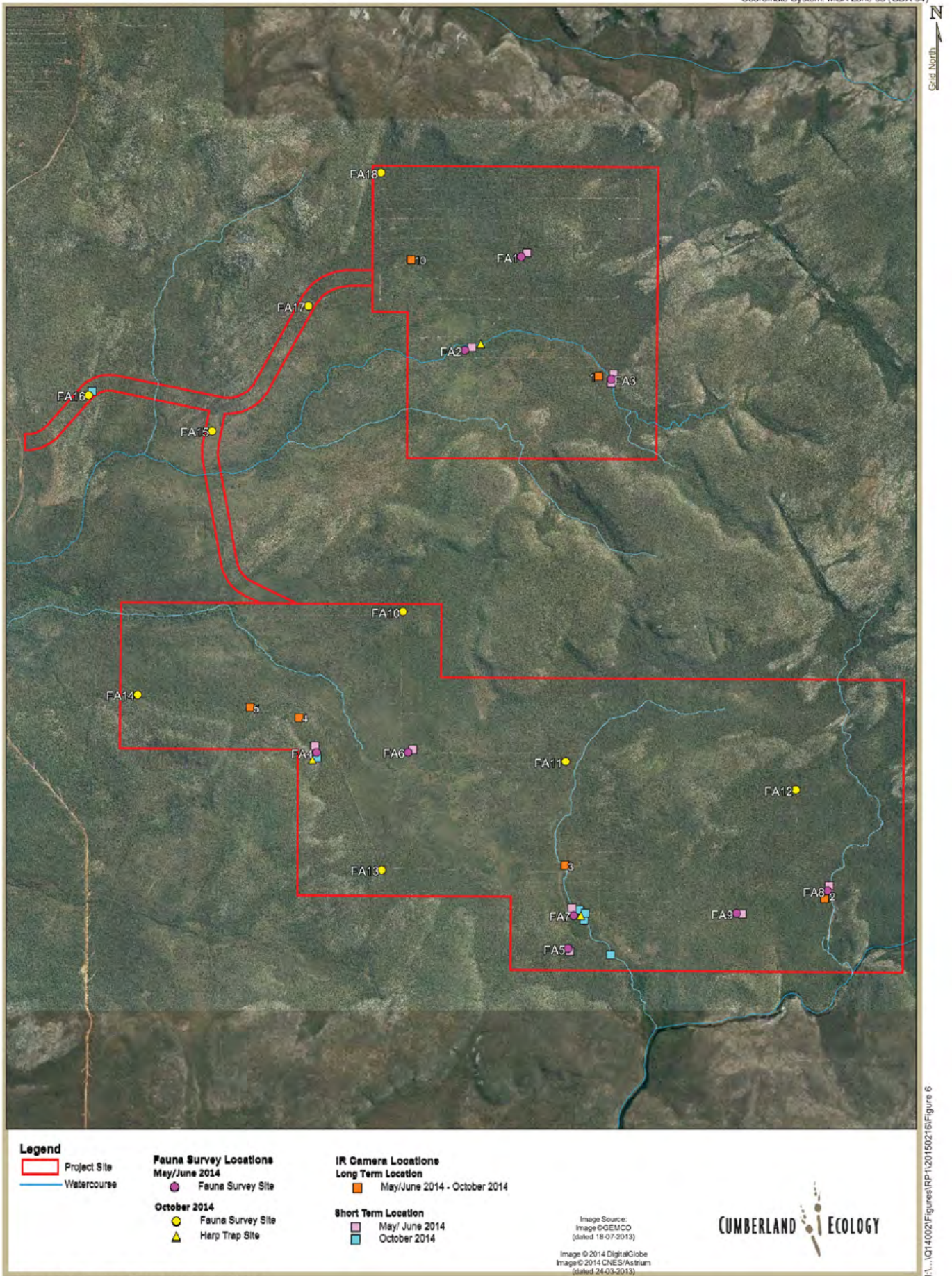


Figure 6. Fauna Survey Locations

I:\...IQ14\021\Figures\RP\1201502\16\Figure 6

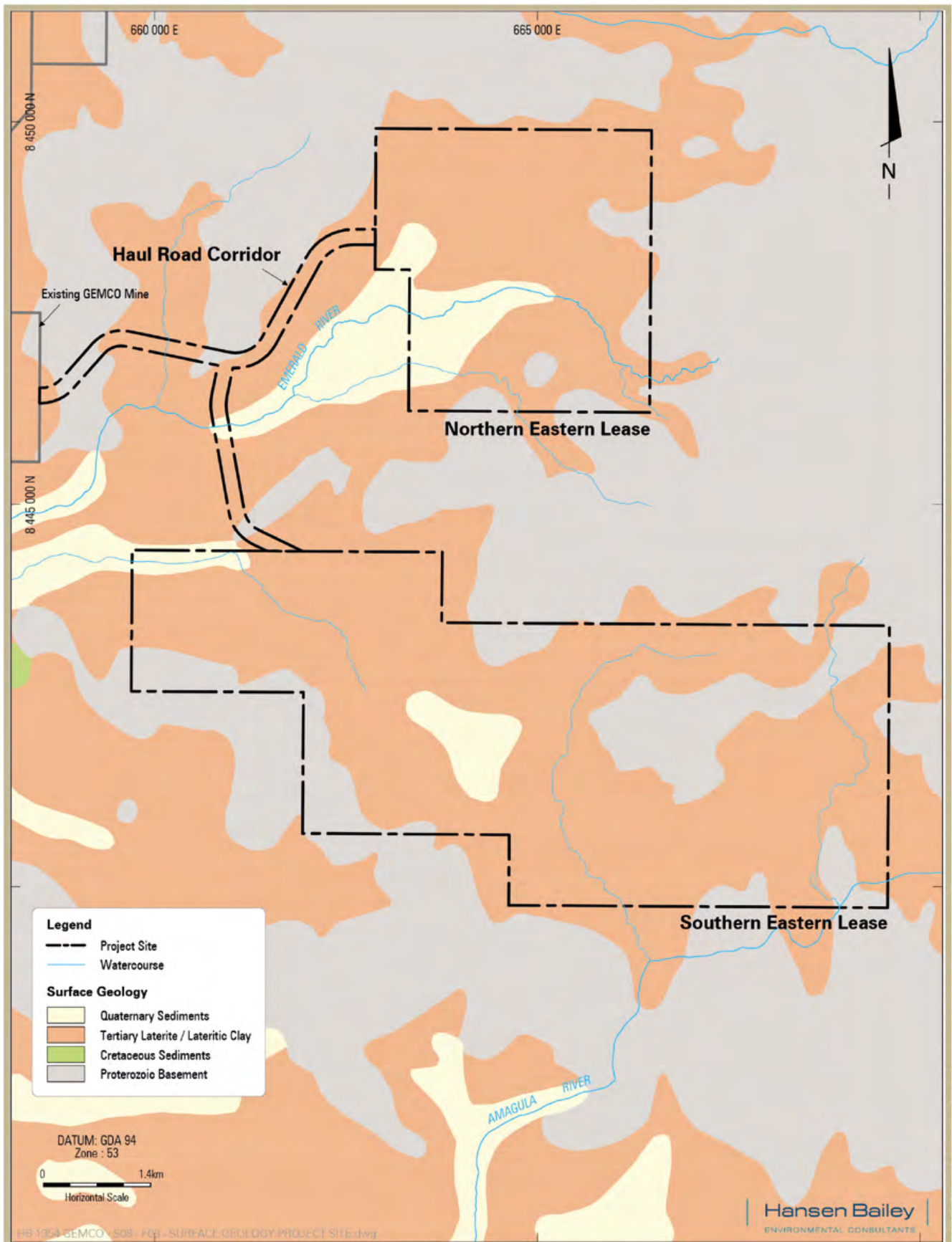


Figure 7. Surface Geology

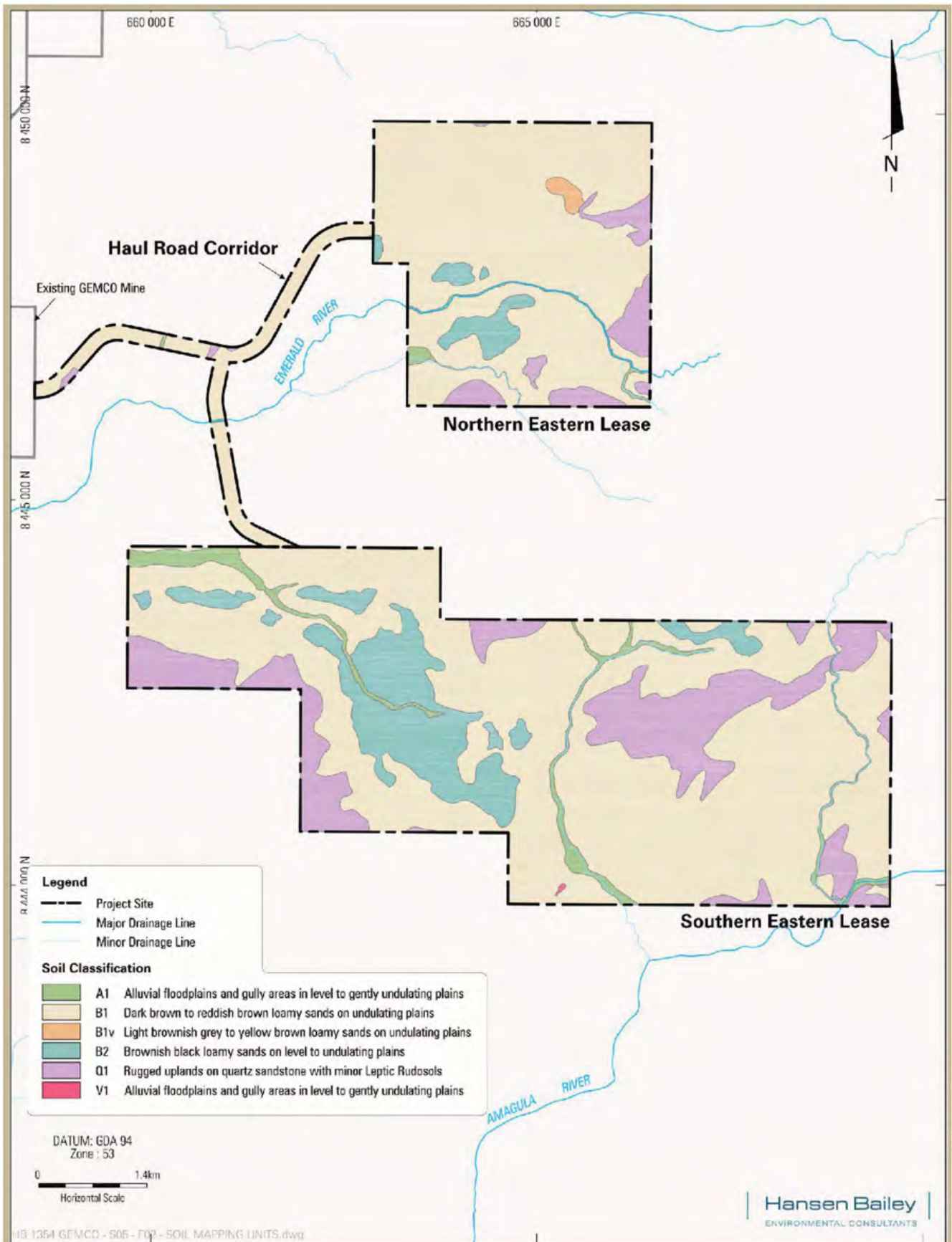


Figure 8. Soils Mapping

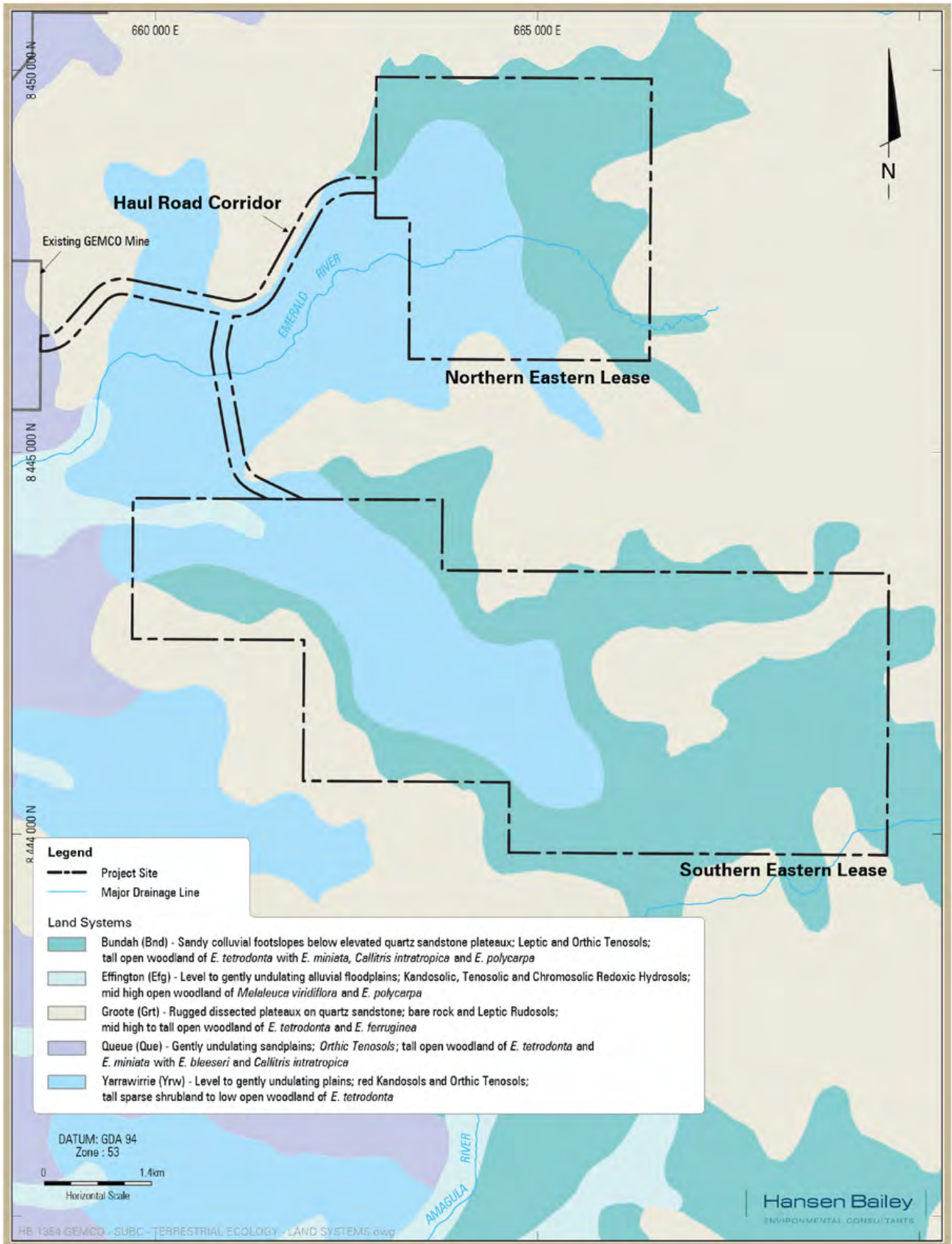


Figure 9. Land Systems Mapping

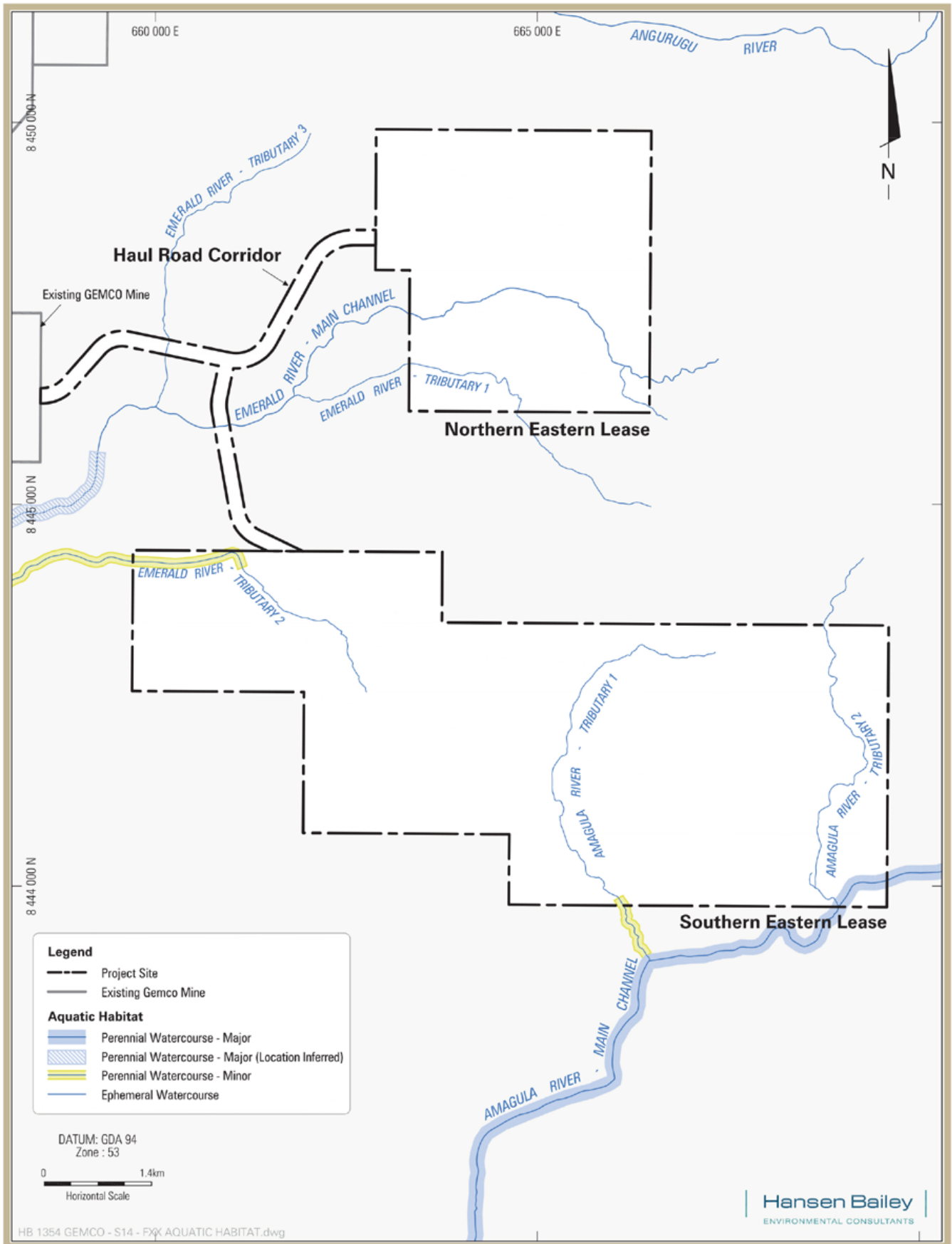


Figure 10. Hydrology

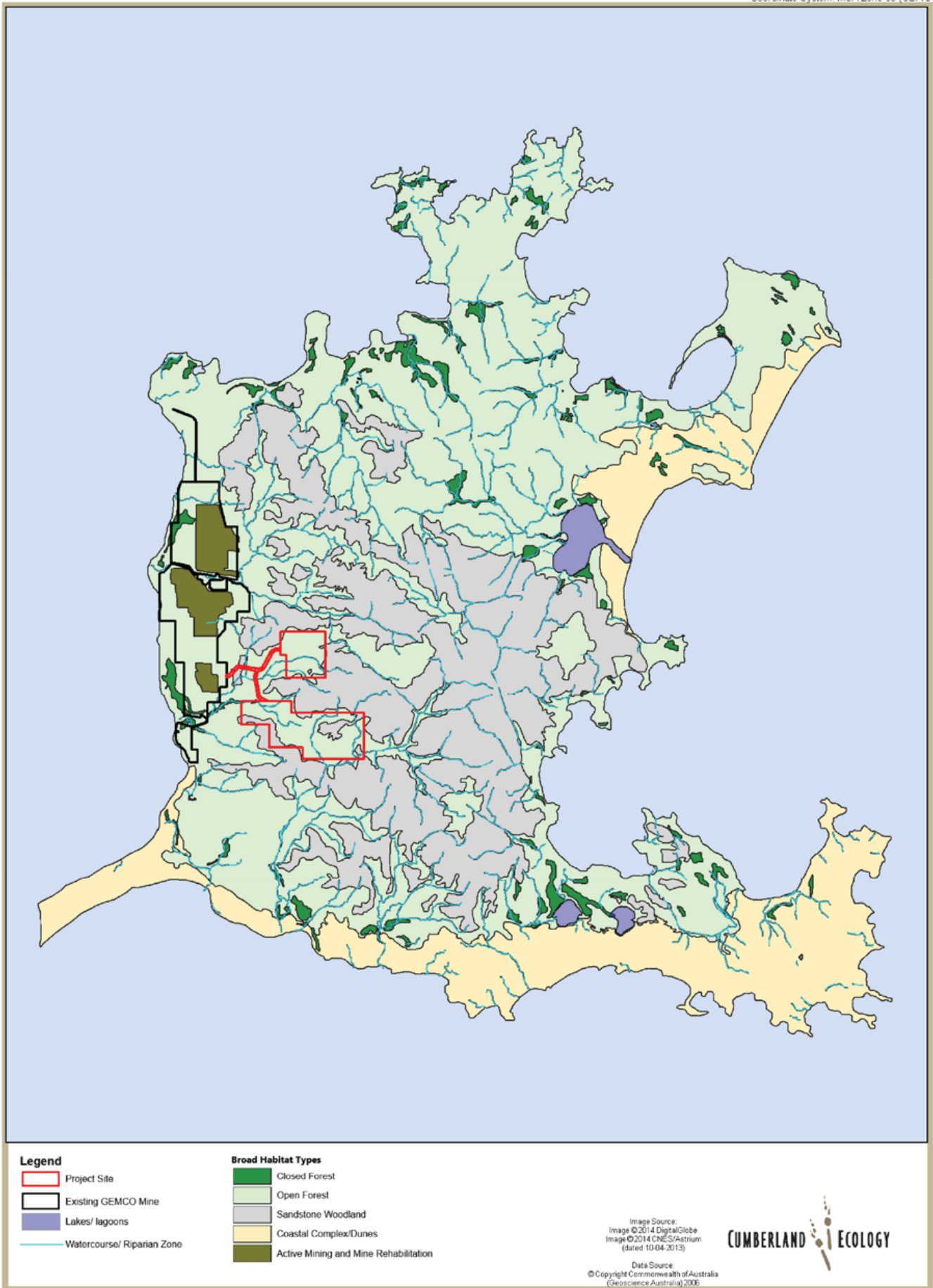


Figure 11. Broad Habitat Types across Groote Eylandt

Coordinate System: MGA Zone 53 (GDA 94)



Figure 12. Previous NT NRM InfoNet Database Records of Threatened Flora on Groote Eylandt

2.5 0 2.5 5 7.5 10 km

I:\...IQ1-4002\Figures\RP1\20141217\Figure 12





Figure 13. Previous NT NRM InfoNet Database Records of Threatened Fauna on Grooteylandt

Coordinate System: MGA Zone 53 (GDA 94)



Figure 14. Previous NT NRM InfoNet Database Records of Migratory Fauna on Groote Eylandt

2.5 0 2.5 5 7.5 10 km

I:\...IQ14002\Figures\RP1\20141217\Figure 14

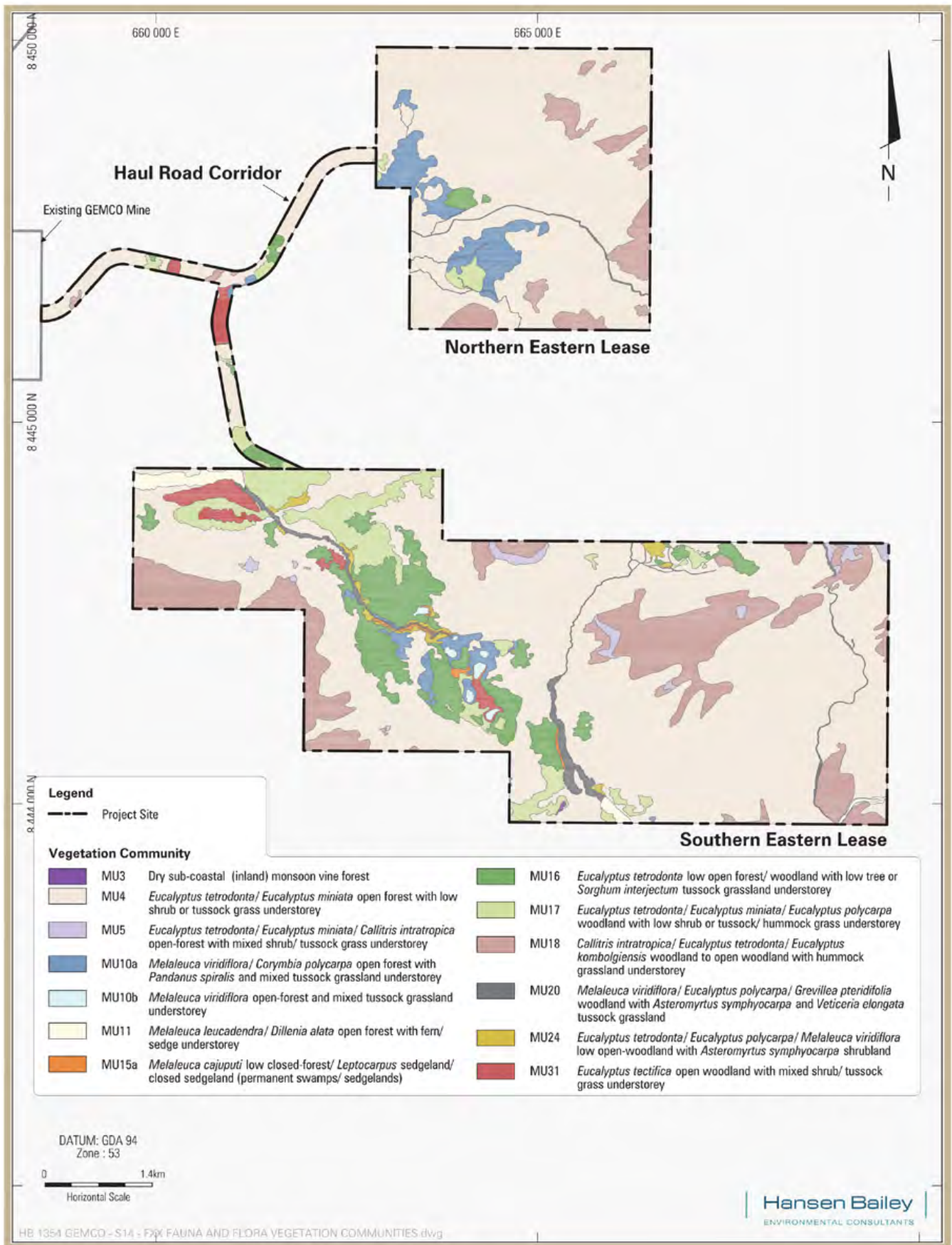


Figure 15. Vegetation Communities within the Project Site

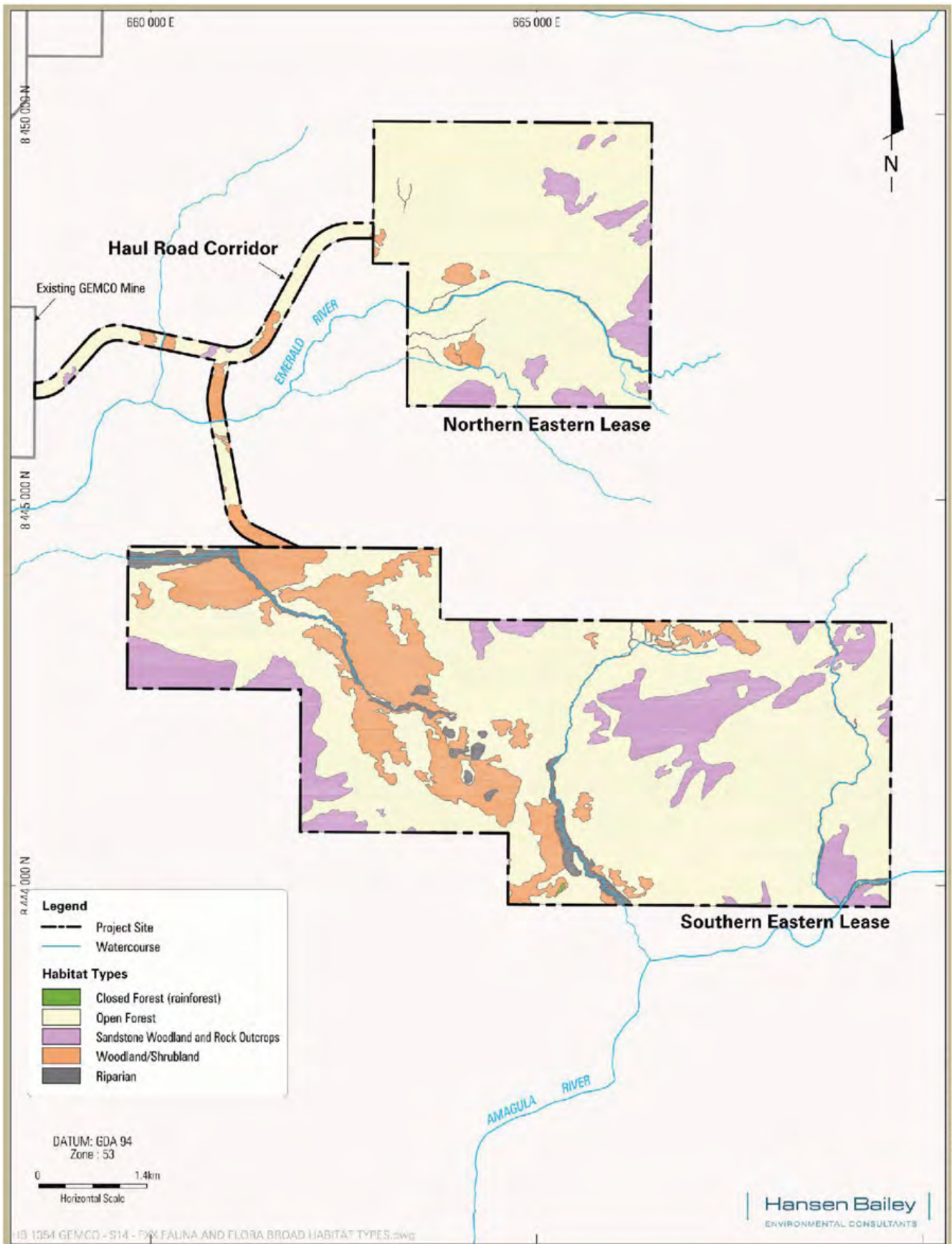


Figure 16. Broad Habitat Types within the Project Site

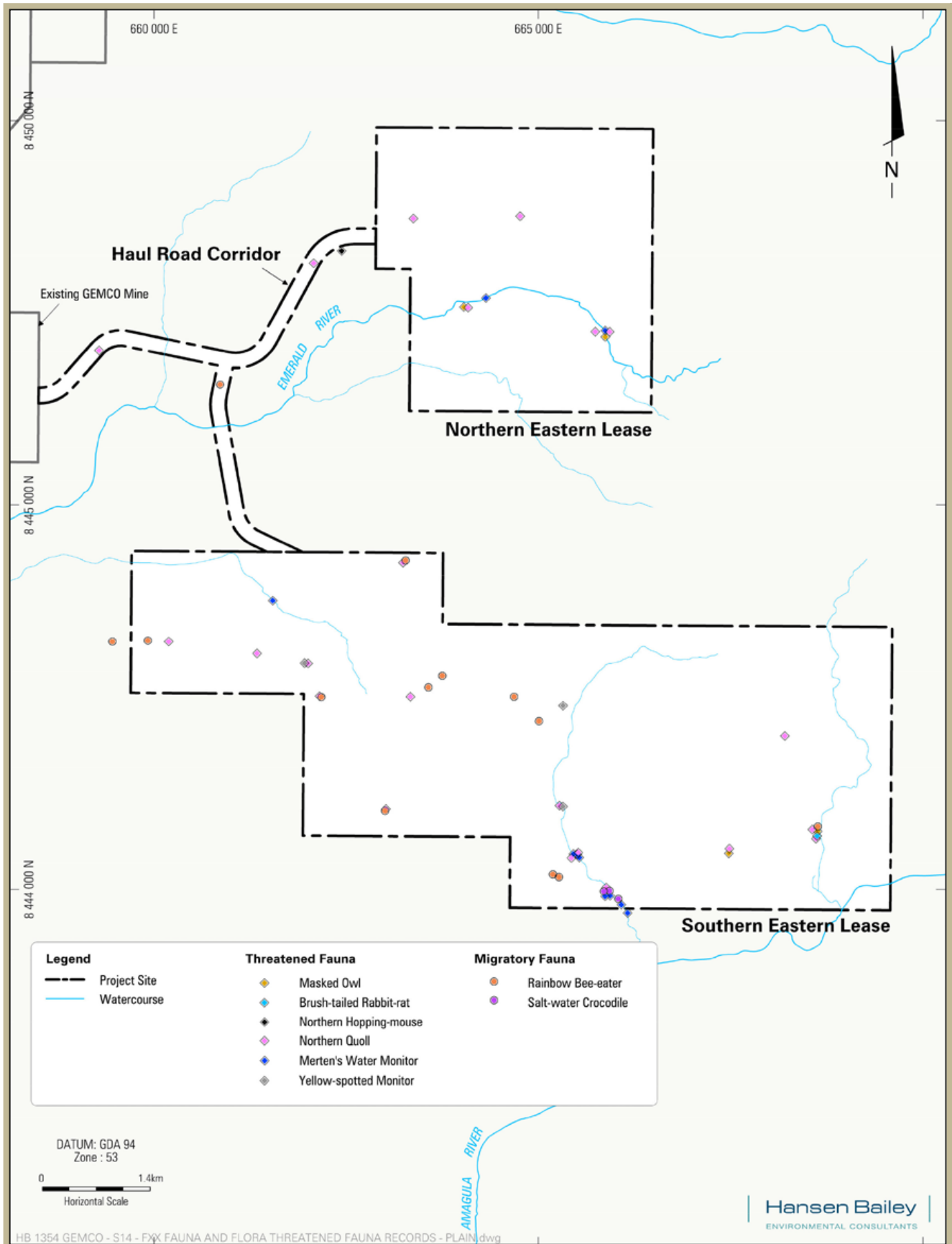


Figure 17. Threatened Fauna Records within the Project Site

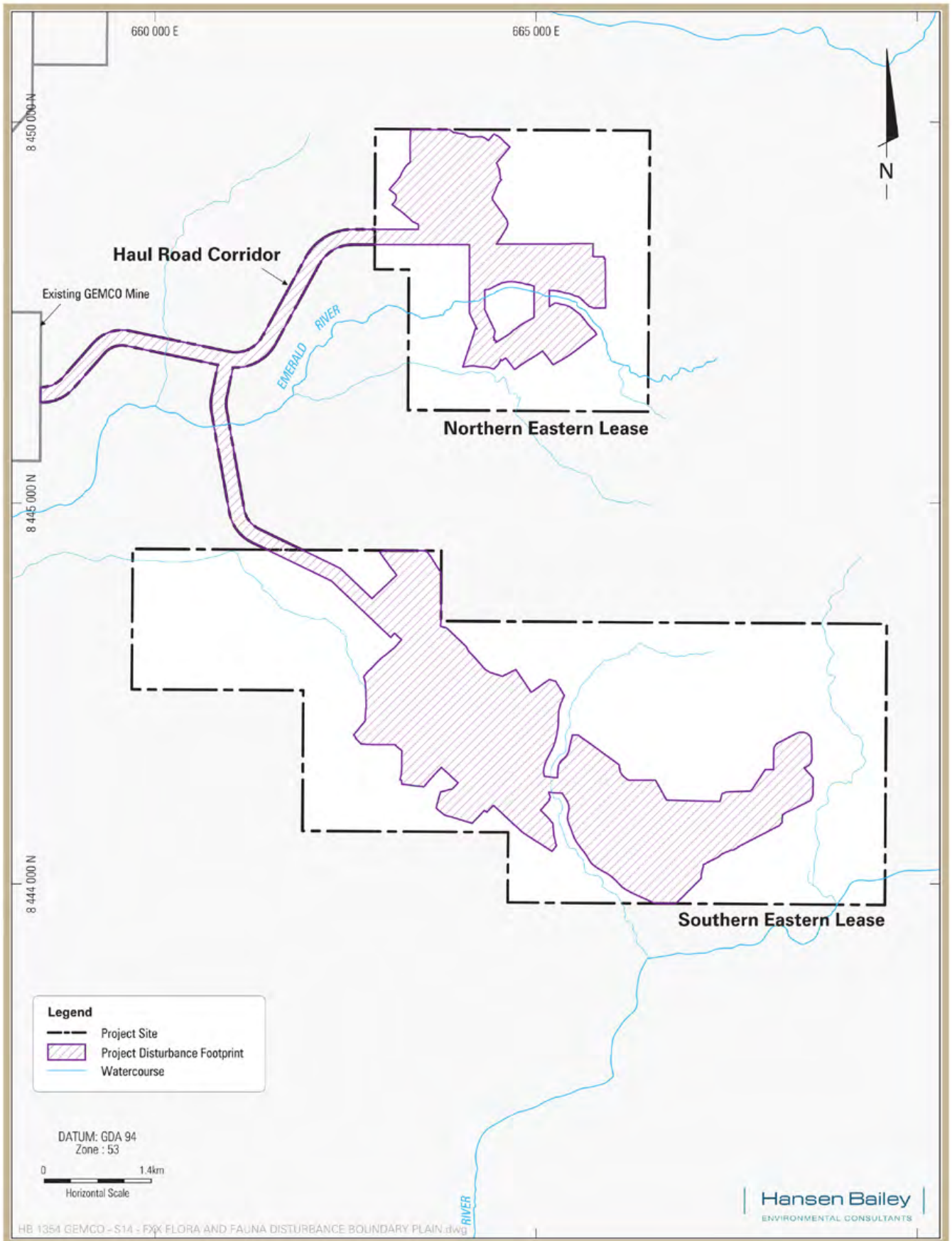


Figure 18. Disturbance Footprint

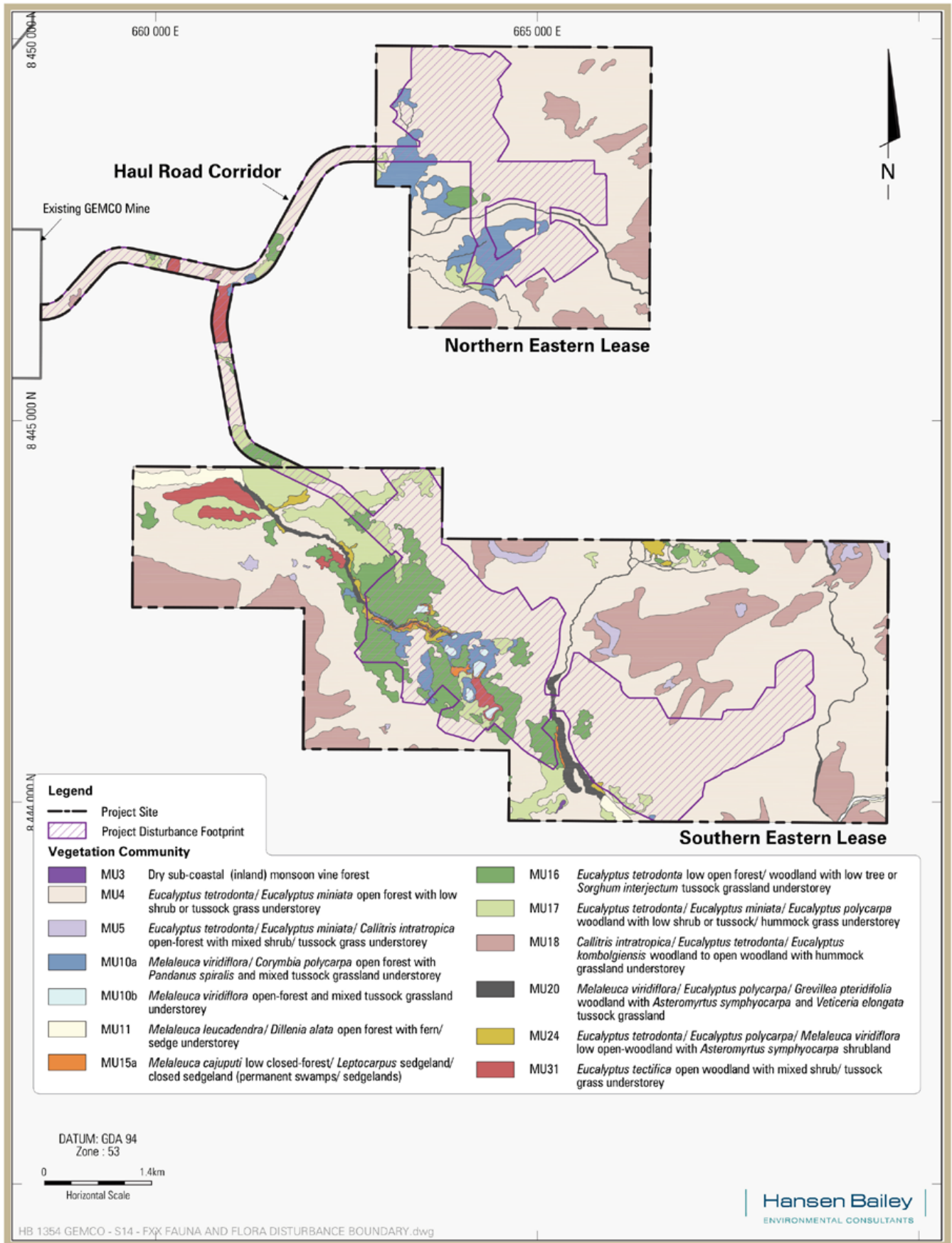


Figure 19. Vegetation Communities within the Disturbance Footprint

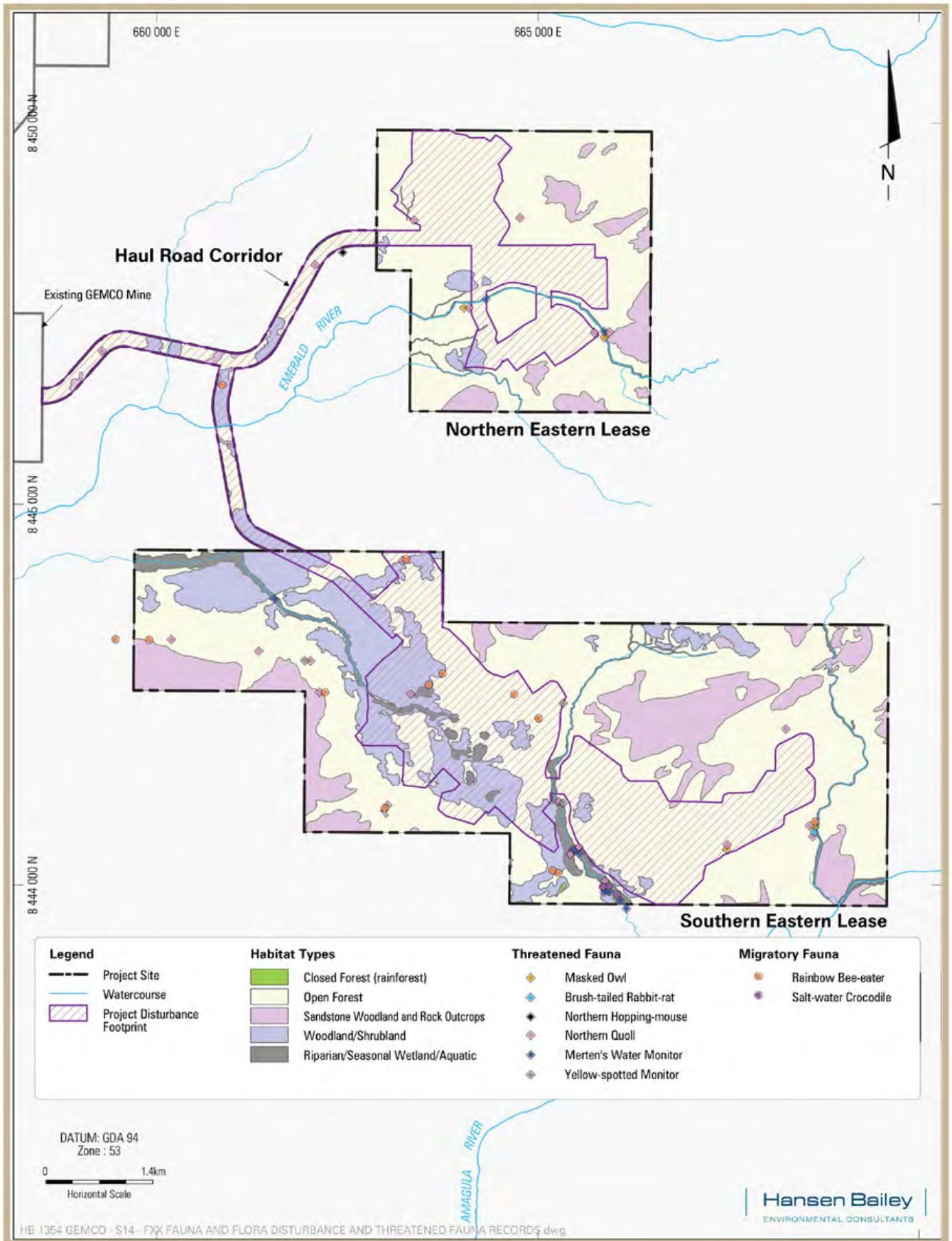


Figure 20. Habitat Types within the Disturbance Footprint





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*Appendix A*

**Project Team CVs**

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# Dr David Robertson

## Director



**Dr David Robertson's** ecological career has spanned 27 years since completion of his PhD at Melbourne University in 1985. He is a specialist ecologist with expertise in both botany and zoology and has worked as an ecological consultant since 1993.

During part of his career, David has also been a lecturer in plant taxonomy, plant ecology and freshwater ecology at Charles Sturt University and Australian Catholic University. This has developed his capability to work in both aquatic and terrestrial flora and fauna inventory, management of threatened species, ecological risk assessment, wetland rehabilitation and management, and ecological research for environmental impact assessment.

Throughout his career, David has worked on a wide variety of ecological projects. This includes ecological projects across Australia, including New South Wales, Queensland, ACT, Victoria, Tasmania and Western Australia. He has also gained international experience as the senior ecologist involved with consultancies in Hong Kong, Sri Lanka and the Philippines.

Since the inception of Cumberland Ecology Pty Ltd in 2003, David and his team of ecologists at Cumberland Ecology have worked on ecological investigations throughout NSW, averaging over 80 projects per year. They have worked extensively within the Hunter Valley, Gunnedah Basin, Sydney Region, on coastal projects and in the Western Blue Mountains.

David has had, and continues to have, direct involvement in many large-scale vegetation mapping and flora and fauna impact assessment projects. David has worked on many projects that entail the preparation of ecological offsets and Cumberland Ecology has been engaged to monitor such offsets. Cumberland Ecology has helped to formulate offsets for many mining projects in NSW, and also for mines in north Queensland and in Mindanao (Philippines).

Under David's direction, an array of monitoring work has been and is being conducted at sites in the Hunter Valley, Gunnedah, Coffs Harbour and Western Sydney.

### Education

Bachelor of Science (Honours), Ecology, University of Melbourne, 1980.

Doctor of Philosophy, Ecology, University of Melbourne, 1986.

David undertook his tertiary education at Melbourne University, completing a Bachelor of Science majoring in botany and zoology. This included a thesis submitted as part of the requirements for the B.Sc. Honours Degree at The University of Melbourne School of Botany:

***Aspects of the Ecology of Eucalyptus sideroxylon (A. Cunn, ex W. Wool) at Point Addis, Victoria (November 1980).***

He completed his Doctor of Philosophy in 1985 at the School of Botany, which was entitled:

***Interrelationships between Kangaroos, Fire and Vegetation Dynamic at Gellibrand Hill Park, Victoria (August 1985).***

### Professional Memberships and Affiliations

Ecological Society of Australia

Ecological Consultants Association of NSW

He is also an accredited BioBanking Assessor.

### Employment History

David has lectured in ecology and aquatic biology at Charles Sturt University. Consultancy employment includes as a senior ecologist with the Australian Museum, senior ecologist in charge of the Ecological Services Practice for ERM Australia, and Director of Cumberland Ecology (current).

*2003- 2013 - Cumberland Ecology: Director*

*1997-2003 - ERM: Senior Ecologist*

Dr David Robertson  
*Director*



1998-1999 - *Australian Catholic University:*  
*Lecturer (part time)*

1995-1996 - *Australian Museum: Senior*  
*Ecological Consultant*

1987-1994 - *Charles Sturt University: Lecturer*

1986-1987 - *University of Melbourne: Research*  
*Fellow*

## Experience

David has been involved in the development of biodiversity offset packages for a number of projects, which have included strategic assessments of land as compensatory habitats and involvement in the development of indirect offsets such as threatened species recovery plans. As part of the development of suitable offsets, David is regularly involved in negotiations with clients and regulators about the level of mitigation measures required for flora and fauna impacts.

Recent examples of projects requiring significant offsets work entailing the selection of suitable remnant vegetation for enduring protection and habitat for threatened species listed under the EPBC Act and TSC Act include the:

- Mt Pleasant Project Modification: involved in the selection and subsequent ecological investigations of candidate offset lands, resulting in a substantial offsets package of over 12,000 ha. Further involvement in the development of an Offset Management Plan designed to effectively manage and monitor the offsets for conservation and ecological gains.
- Maules Creek Coal Project is a large-scale flora and fauna baseline study of 2,700 hectares of forest and woodland in the locality of Narrabri, New South Wales. The purpose of the study, which has been ongoing since 2008, was to assess the potential impacts of proposed open cut mining on biodiversity. Key biodiversity values of the Project Area include a number of threatened bird and bat species as well as threatened ecological

communities such as the critically endangered Box Gum Woodland.

- Warkworth Mine Extension Project: assistance in the development of an approved offset package. Involved in fauna surveys of the offsets to provide baseline data on their ecological value, particularly for threatened species, and which fulfil a component of the Project's conditions of consent.
- Drayton South Coal Project: involved in the strategic selection and survey, including vegetation mapping, flora and fauna investigations, of suitable offsets.
- Shenhua Watermark Coal Project; presents a complex suite of ecological issues including Critically Endangered and Endangered Ecological Communities (including areas of Box Gum Grassy Woodland), threatened flora and fauna. In particular Koalas, an iconic species for which the area is well known, are present within the proposed Watermark Project Boundary. This has resulted in extensive surveying and mapping of suitable offsets.
- Bengalla Mine Project involves the preparation of an EIA to support a State Significant Development application. The Project impacts include clearing of Box Gum Woodland and Derived Native Grassland, as well the removal of habitat for a range of threatened species and an endangered population. This has involved negotiations with State and Federal Government Authorities to develop appropriate offsets for the Project impacts. This includes participation in the Upper Hunter Strategic Assessment. Cumberland Ecology is currently preparing an Assessment Report for submission as part of the UHSA, including summary of the results of extensive flora and fauna survey and calculations using the Biodiversity Certification Assessment Methodology (BCAM).

# Dr Alexander Pursche

## *Project Manager / Ecologist*



**Alex Pursche** is a Project Manager and Ecologist at Cumberland Ecology, based in Sydney. He has a PhD in Ecology, and a Bachelor of Science (Hons) in Ecology.

Alex has eight years experience in fauna monitoring, four of which have been gained working as an environmental contractor for mining and infrastructure clients in New South Wales, Queensland, and the Northern Territory. This included assessment of offset properties, subsidence monitoring, and environmental impact assessment studies for powerlines, pipelines, roadways, urban developments, and mines.

He has extensive experience in identifying terrestrial and marine vertebrate fauna including birds, mammals, reptiles, amphibians, and fish. Alex has experience operating in remote conditions and consistently delivers large scale surveys to clients in a timely manner.

Alex has experience in Geographic Information Systems (GIS - ArcMap) and uni-/multi-variate statistical analysis relevant for testing hypotheses for complex ecological interactions. Alex also has the capacity to produce reports to a high standard suitable for publication in peer reviewed scientific journals.

Recent consultancy work has included:

- Biodiversity Management Plans;
- Fauna monitoring studies;
- Species Impact Statements;
- Production of digitised maps; and
- Ecological impact assessment.

### Key Industry Sectors

- Mining;
- Linear Infrastructure;
- Residential development; and
- Conservation.

### Education

Doctor of Philosophy, University of NSW 2013

Bachelor of Science (1<sup>st</sup> Class Honors) 2006

### Fields of Competence

- Fauna Surveys;
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Threatened Species Conservation Act 1995*;
- NSW *Fisheries Management Act 1994*;
- NT *Territory Parks and Wildlife Conservation Act 2000*; and
- QLD *Nature Conservation Act 1992*.

### Key Projects

#### ***Mount Pleasant Offset Management Plan***

Alex is managing the assessment of offset properties for the Mount Pleasant Project (Rio Tinto Coal Australia). This project will see baseline data collected to determine any effects of biodiversity management between 2013 and 2020.

#### ***Ecological Impact Assessments***

Alex has written fauna and flora impact assessments for residential developments for Great Lakes, Bankstown, Warringah, and Pittwater LGAs.

#### ***Fauna Monitoring***

Since 2010, Alex has worked monitoring vertebrate fauna for large scale mining and infrastructure projects. Tasks included general fauna assessment as well as targeted searches for *EPBC Act* and *TSC Act* listed threatened species. Recent clients include Rio Tinto, Centennial Coal, Glencore (Xstrata), BHP, LendLease, and Leighton.

# Katrina Wolf

## *Senior Project Manager / Ecologist*



**Katrina Wolf** is a Senior Project Manager/Ecologist at Cumberland Ecology, based in Sydney. She has a Bachelor of Science (Environmental) with majors in Environmental Science and Biology (Ecology).

Katrina has been involved in flora and fauna surveys, impact assessment, ecological monitoring and GIS. Recently, she has managed several State Significant Developments and Section 5A assessments with endangered ecological community, threatened species and offsetting issues. Katrina has experience in designing and implementing targeted threatened flora and fauna surveys.

Recent consultancy work has included:

- Flora and fauna impact assessments for State Significant Developments;
- BioBanking Assessments on both development and offset sites;
- Development of vegetation management plans; and
- Preparation of offset principles and guidelines for major projects.

### Fields of Competence

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Threatened Species Conservation Act 1995*;
- NSW *Environmental Planning and Assessment Act 1979*;
- BioBanking Assessments;
- Ecological survey and monitoring;
- Report writing; and
- Geospatial Information Systems (GIS).

### Key Industry Sectors

- Extraction industry; and
- Urban development.

### Education

- Bachelor of Science (Environmental).  
The University of Sydney, 2007
- BioBanking Assessors Training Course  
TAFE Ryde

### Key Projects

#### ***Warkworth Mine***

Katrina assisted in the preparation of an Ecological Impact Assessment for the Warkworth Mine Project. She also undertook flora and fauna surveys both within the development area and offset areas. More recently, she has worked on the preparation of a revised ecological assessment of the project, including the BCAM assessment.

#### ***Watermark Coal Project***

Katrina is currently the Project Manager for the Watermark Coal Project. Her involvement has included consultation with DoE, OEH and Namoi CMA, assistance in the preparation of an Ecological Impact Assessment, MNES Report and Koala Plan of Management, as well as field assessments of potential offset properties.

#### ***Bylong Coal Project***

Katrina is currently the Project Manager for the Bylong Coal Project. Her involvement has included consultation with DoE and OEH, preparation of an Ecological Impact Assessment, field surveys, and development of the offset package.

#### ***Department of Planning Part 3A Offset Guidelines***

Katrina worked closely with the Department of Planning to develop a set of offset principles and guidelines for Part 3A projects. Her involvement included consultation with the Department of Planning, background research, attendance at a workshop of experts and document preparation.

#### ***Management Plans and Monitoring***

Katrina has assisted with the development of several management plans for mining projects in NSW, and has been involved in monitoring programs in western Sydney and the Hunter Valley. Such projects have involved monitoring of vegetation and animal population census.

# Dr Gitanjali Kattrak

## *Project Manager / Ecologist*



**Gitanjali Kattrak** is a Project Manager/Ecologist at Cumberland Ecology, based in Sydney. She has a Bachelor of Sciences (Biological Sciences) with Honours and a PhD in intertidal wetland ecology.

Gitanjali has been involved in terrestrial and aquatic surveys, impact assessments, ecological monitoring and statistical analyses. She has also managed State Significant Developments and Section 5A assessments with endangered ecological community and threatened species issues. Gitanjali has also been involved in the preparation of Statements of Evidence for the NSW Land and Environment Court.

Recent consultancy work has included:

- Flora and fauna impact assessments for State Significant Developments, Part 3A projects and Part 5 projects;
- Vegetation mapping, aquatic surveys and targeted threatened species habitat assessment and surveys;
- Impact assessment and offsetting for mining projects; and
- Statistical analyses for ongoing monitoring programmes.

### Fields of Competence

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999;*
- *NSW Threatened Species Conservation Act 1995;*
- Terrestrial and aquatic ecological surveys, particularly aquatic invertebrate identification and assessment of threatened species and ecological communities; and
- Statistical analyses.

### Key Sectors

- Urban development; and
- Mining and Extraction industries.

### Education

- Bachelor of Science (Honours) in Biological Sciences, La Trobe University, VIC. 2002
- Doctor of Philosophy, Intertidal Wetland Ecology. Flinders University, SA. 2011

### Key Projects

#### ***Wallarah 2 Coal Project***

Gitanjali is currently managing the Ecological Impact Assessments and Offset Strategy for the Development Application of the State Significant Wallarah 2 Coal Project.

#### ***St. Mary's Development – Lend Lease***

Gitanjali is involved with the progressive development of the former ADI site at St Marys, Western Sydney. Assessments have included the preparation of large scale Species Impact Statements for the Development Precinct DA's and ongoing monitoring within the Regional Park.

#### ***Land and Environment Court cases***

Gitanjali has been involved in court proceedings for several Land and Environment court cases dealing with a variety of issues, including aquatic pollution, groundwater dependent ecosystems, threatened species issues and offset strategies.

#### ***Flora and fauna surveys***

Gitanjali has been involved in ecological assessments including Species Impact Statements and Flora and Fauna Assessments as part of development applications for a variety of projects in the greater Sydney Metropolitan area.

#### ***Statistical analysis***

Gitanjali has experience conducting statistical analyses, using programmes such as SPSS and PRIMER, to determine biological patterns and community structure.

# Aleksei Atkin

## *Project Manager / Ecologist*



**Aleksei Atkin** is a Project Manager/Ecologist at Cumberland Ecology, based in Sydney. Aleksei has worked in New South Wales, Queensland and the Northern Territory on numerous projects with threatened species and/or endangered ecological community issues and is experienced in assessing projects in response to threatened species legislation.

Specifically, Aleksei has expertise in targeted fauna survey including:

- Microchiropteran bat trapping and call analysis;
- Ornithological surveys and mist netting;
- Arboreal and terrestrial mammal trapping; and
- Reptile and amphibian surveys.

Additionally, Aleksei has experience in terrestrial restoration ecology, bush regeneration, flora surveys and mapping vegetation communities for a variety of projects, including residential subdivisions, linear infrastructure and mining.

Recent consultancy work has included:

- Flora and fauna impact assessments for Major Projects;
- Preparation of Vegetation and Bushland Management Plans;
- Pre-clearing surveys, clearing supervision and nest box monitoring;
- Targeted threatened fauna habitat assessment and survey;
- Vegetation community mapping; and
- Monitoring of impacts from approved activities on ecological issues.

### **Fields of Competence**

- Ecological field surveys and biological monitoring
- Environmental impact assessment;
- Preparation of ecological management plans;

- Monitoring environmental restoration performance criteria; and
- Bushland Regeneration.

### **Key Industry Sectors**

- Urban development;
- Mining and Extraction industries; and
- Government utilities.

### **Education**

Bachelor of Natural Science majoring in Nature Conservation, University of Western Sydney

Currently completing Masters of Wildlife Management, Macquarie University

### **Key Projects**

#### ***Targeted Fauna Surveys***

Aleksei has conducted targeted surveys for numerous threatened fauna species on large scale infrastructure and mining projects. These surveys include habitat assessments, survey design, trapping and identification.

#### ***Flora and Fauna Impact Assessment within the Sydney region***

Aleksei has been involved in numerous ecological assessments including Species Impact Statements and Flora and Fauna Assessments as part of development applications for a variety of projects.

#### ***Nest Box Monitoring and Pre-clearing surveying***

Aleksei has conducted and implemented nest box management plans, pre-clearing surveys and clearing supervision on high profile infrastructure and mining projects.

#### ***Macropod Management Plans***

Aleksei is experienced in the preparation and implementation of macropod management plans for the Dept. of Defence.

# Cecilia Phu

## *Senior Project Manager / Botanist*



**Cecilia Phu** is a senior project manager and botanist at Cumberland Ecology based in Sydney. She has a Bachelor of Science (Honours) with a major in Biology.

Cecilia has been involved in numerous ecological impact assessment projects with threatened species and endangered ecological community issues, and routinely assesses projects in response to State and Commonwealth threatened species legislation. Her work entails vegetation mapping, targeted survey for threatened species, impact assessment and report preparation. Cecilia manages major ecological impact assessments, biodiversity offsetting and management projects.

Cecilia also has experience in survey design, community and population data analysis (SPSS and ePRIMER), as well as collection, storage and analysis of geospatial data in order to provide key strategic advice to clients and department agencies (CivilCad, MapInfo). Recent consultancy work has included:

- Vegetation mapping;
- Flora and fauna impact assessment;
- BioBanking assessments;
- Offset assessments via EPBC offsetting policy;
- Development of bushland management plans with focuses on threatened species habitat management, weed control and bush regeneration;
- Monitoring studies for approved activities.

### **Fields of Competence**

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;
- NSW *Environmental Planning and Assessment Act 1979*;
- NSW *Threatened Species Conservation Act 1995*;
- BioBanking Assessors Training Course at TAFE Ryde;
- Botanical survey, biological monitoring, pre-clearing and clearing surveys and environmental impact assessment; and
- Geospatial Information Systems (GIS).

### **Key Industry Sectors**

Urban, industrial and logistics, infrastructure, extraction.

### **Education**

Bachelor of Science, University of Sydney, 2006.

Bachelor of Science (Honours) in Biology, University of Sydney, 2008

### **Key Projects**

#### ***Flora and Fauna Impact Assessments***

Cecilia has over six years experience in conducting and managing ecological assessments in the Hunter region and the Gunnedah Basin for major mining projects. Additionally she has worked within the Galilee and Bowen Basins in north Queensland. Cecilia has also worked extensively in the Sydney Metropolitan area and has particular experience within the Sydney Growth Centres and the Western Sydney Employment Area.

#### ***BioBanking Assessments***

Cecilia has assessed a number of impacts and offsets for projects using the BioBanking assessment methodology in the Sydney Basin and Hunter Valley regions. Work has included vegetation mapping, flora and fauna surveys and habitat assessments. Data collected during fieldwork was utilised within the BioBanking Credit Calculator.

#### ***Management Plans and Monitoring***

Cecilia has prepared management plans for development and offsetting projects in the Sydney, north east NSW and western NSW areas. Such projects have involved monitoring of grazing, vegetation restoration and animal population census.

#### ***Other Projects***

Cecilia has been involved in terrestrial and aquatic ecology studies for a gold mining project in the Philippines. She has worked closely with local botanists and zoologists in the Philippines and was involved in the preparation of the terrestrial ecology and aquatic reports for the Project's international Environmental Impact Statement.



# Michelle Frolich

## *GIS Specialist*



**Michelle Frolich** is a Sydney based GIS Specialist at Cumberland Ecology. She has detailed technical knowledge and experience in the interpretation and production of mapping products, including topographic modelling and classification and feature extraction using aerial photography and satellite imagery.

Michelle also has extensive experience in BioBanking and Bio-Certification Assessment Methodologies, and has attended a workshop on the Draft Framework for Biodiversity Assessment. Michelle is closely involved in all major projects and is responsible for GIS development, mapping and analyses, as well as the training of staff in GIS.

Recent consultancy work has included:

- GIS mapping and analysis for various mining projects for Environmental Assessments, Biodiversity Management Plans, major project applications and Referrals under the Commonwealth EPBC Act;
- Vegetation, threatened flora and fauna mapping for large- and small-scale projects;
- GIS mapping for and performing BioBanking assessments on large and small development and offset sites;
- GIS mapping for and performing Bio-Certification assessments for mining projects involved in the Upper Hunter Strategic Assessment; and
- GIS mapping for and performing assessments using the Draft FBA for Major Projects.

### **Fields of Competence**

- Geographic Information Systems (GIS);
- Image and spatial data analysis;
- BioBanking Assessment Methodology;
- OEH Bio-Certification Assessment Methodology;
- OEH Framework for Biodiversity Assessment; and
- Data and project management.

### **Key Industry Sectors**

- Urban Development; and
- Extraction industry.

### **Education**

Bachelor of Science (Marine Science) (Honours), University of Sydney, 2007.

### **Key Projects**

#### ***NSW and Queensland Mining Projects***

Michelle has extensive experience working on GIS mapping for Part 3A Major Projects / State Significant Projects relating to mining in the Central Hunter Valley and Namoi CMA, NSW and in Western Queensland . She has been involved in the GIS mapping of vegetation communities, threatened flora and fauna species, produced detailed maps for field surveys, and high quality maps for reports.

#### ***OEH Upper Hunter Strategic Assessment***

Michelle has been involved in the preparation, mapping and reporting for Biodiversity Certification Assessments for mining projects in the Upper Hunter Valley as part of the OEH Upper Hunter Strategic Assessment. She regularly liaises with OEH and has attended several workshop meetings.

#### ***BioBanking Assessments***

Michelle has been involved in the mapping for and assessment of projects using the BioBanking Assessment Methodology for small and large projects in the Sydney Basin, Hunter Valley and Namoi CMA. She has extensive experience using collected data within the BioBanking Credit Calculator, and in producing high quality maps for BioBanking Assessment reports. She has also assisted with field surveys to collect flora and fauna data as per the BioBanking Assessment Methodology field methodology.

#### ***Other Projects***

Michelle has also worked on several other small scale projects in Sydney and throughout NSW, using GIS for the mapping of vegetation communities, threatened flora and fauna species, the production of field maps and image analysis, and produced high quality maps for reports. She has also assisted with field surveys for flora and fauna.

# Cecilia Eriksson

## *GIS Technician / Ecologist*



**Cecilia Eriksson** is a Sydney based GIS Technician and Ecologist at Cumberland Ecology. She has a Master of Science degree in Marine Science and Management, and a Bachelor of Science (Honours) in Marine Biology.

Cecilia has detailed technical knowledge and experience in the interpretation and production of digitised mapping, including topographic modelling and classification and feature extraction using aerial photography and satellite imagery. Cecilia is involved in major projects and is responsible for GIS development, mapping and analyses.

Additionally, she has obtained extensive experience in complex statistical analyses in the fields of environmental and social sciences, with competency in both SPSS and Primer software.

Recent consultancy work has included:

- GIS production of vegetation and threatened species maps and spatial data analysis;
- GIS mapping for Queensland and New South Wales mining projects, large scale housing developments and government infrastructure projects; and
- GIS preparation for BioBanking assessments.

### **Fields of Competence**

- Geographic Information Systems (GIS);
- Image and spatial data analysis;
- Statistical analysis (SPSS and Primer); and
- Data and project management.

### **Key Industry Sectors**

- Urban Development; and
- Extraction industry.

### **Education**

Master of Science in Marine Science and Management

University of Technology Sydney (2013)

Bachelor of Science (Honours) in Marine Biology  
University of Technology Sydney (2008)

### **Key Projects**

#### ***NSW Infrastructure Projects***

Cecilia has been involved in the GIS mapping of vegetation communities, threatened flora and fauna species, high value habitat features, and the production of detailed maps for field surveys. She has also been responsible for the calculation of clearance areas of native vegetation.

#### ***Extraction Industry Projects***

Cecilia has been involved in the production of soil and geology maps, as well as detailed mapping of vegetation communities over 5000 ha, and production of field maps for major projects relating to mining in New South Wales, Queensland and the Northern Territory. Additionally, she has been responsible for the mapping of threatened flora and fauna species records, and areas of high and low value habitats associated with threatened species, in the areas of interest and surrounds.

#### ***Other Projects***

Cecilia has also worked on several large and small scale housing development projects in Sydney and throughout NSW. This has involved using GIS for broad-scale and detailed vegetation mapping, evaluation of watercourses, mapping of threatened flora and fauna species, LIDAR-survey mapping, Asset Protection Zone modelling, spatial analysis, and production of field maps.

**JON SCHATZ****Curriculum Vitae**

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**Email:** Jon.Schatz@csiro.au

**Citizenship:** Australian

**DOB:** 10/8/73

**Drivers Licence:** Current NT Class C

**Accreditations:**

- St John Ambulance Apply First Aid Certificate
- TFITB Chainsaw Operators Certificate (Faller non forest harvesting)
- S.M.A.R.T. NT Driver Training Certificate (4WD)
- S.M.A.R.T. NT Driver Training Certificate (ATV)
- NT Firearms Licence – Class A & B
- NT Bushfires Council Level I & Fire Awareness (Basic)

**Other training:**

- Capacity Building in Indigenous Communities Workshop
- Basic Welding (Adult Night Classes)
- Basic Small Engine Maintenance
- Hand Tools/Hand Held Operations Certificate
- National Farm Chemical User training
- CSIRO OHSE for Supervisors & Staff
- Fire Warden Training
- Industrial Radiation Safety Level 2 for Moisture/Density Gauges

**Permits:**

- NT Aboriginal Lands Permit (Entry/work on all Aboriginal Land & Seas)
- NT Wildlife Take - Plants and Invertebrates
- NT Ochre Card (Working with Children) clearance

**Education:**

**1992-1995**      **Bachelor of Science Degree – Northern Territory University**  
Major - Biological Sciences      Minor – Earth Science

**Work History:****Present position****2002 – Current****CSIRO Ecosystem Sciences, Darwin.**

Position: Technical Officer (CSOF4)

Program: Ecology

Duties: Organise and conduct field assessments at registered and remote sites throughout the Top End including, Kakadu, Arnhem Land, Tiwi Islands, Victoria River Region, Kimberley and Gulf of Carpentaria. Activities include studies on vegetation structure and floristics, carbon stocks and gaseous emissions, fire and grazing impacts, mine site rehabilitation and pest ant assessment and control.

**Previous positions****1996 – 2002****CSIRO Plant Industry, Darwin.**

Position: Technical Officer (GL3)

Program: Mango, Cashew and New Crops

Duties: Oversee crop management and data collection for tropical research trials in orchards in the Top End, Kimberley and Far North Queensland.

**1996 – 1996****CSIRO Entomology, Darwin.**

Position: Technical Officer (GL3)

Project: Biological Control of *Mimosa pigra*.

Set up, maintain and monitor various biological control trials for the woody weed *Mimosa pigra*. Trial locations include local greenhouses and field trials in remote locations in the Top End.

**Awards:**

**2007 - Australian Museum Eureka Prize**

Innovative Solutions to Climate Change (Team)

**2007 - NT Government Research & Innovation Awards**

Tropical Knowledge Research Award - Finalist (Team)

**2013 – CSIRO Ecosystem Sciences Divisional Awards**

Outstanding Team Award

**Additional Interests**

Native plants, camping, bushwalking, masters athletics, volleyball.

**Referees:**

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*Appendix B*

# Mine Rehabilitation Report

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## B.1 Introduction

This appendix documents the findings of a vertebrate fauna assessment of selected mature mine rehabilitation areas at the existing GEMCO mine. Please note that all section references in this appendix are references to the main body of the Terrestrial Ecology Impact Assessment.

The objectives of this mine rehabilitation area fauna assessment were to:

- Identify fauna species utilising the habitats within mine rehabilitation areas; and
- Provide a comparison of the utilisation of the habitat within mine rehabilitation areas by fauna in relation to the faunal assemblage occurring within the project site.

Mine rehabilitation is an important component of the project as it is a key mitigation measure proposed to minimise the impact of the project on terrestrial flora and fauna values. As such, it is considered necessary to provide a level of information to allow for an assessment of the adequacy of measures to achieve the desired outcome.

## B.2 Methodology

### ***B.2.1 Database Analysis and Literature Review***

This assessment draws upon the detailed database analysis and literature review that was undertaken as part of the terrestrial ecology assessment in the main body of this report (see **Section 3.1.1** and **Section 3.1.2**). The key document relevant to fauna utilisation of mine rehabilitation area is *Flora and Fauna Surveys of Western Groote Eylandt* (URS Australia Pty Ltd, 2012). This report documents flora and fauna surveys in the western part of Groote Eylandt, including surveys undertaken in areas of mine rehabilitation.

### ***B.2.2 Field Surveys***

#### *i. Overview*

Vertebrate fauna surveys undertaken within the mine rehabilitation areas included:

- IR camera trapping (25 May – 4 October 2014); and
- Detailed fauna survey: trapping, bird surveys, active searches, bat surveys, infra-red camera surveys, fauna habitat assessments (13 – 16 October 2014).

The methodology undertaken for fauna surveys within the mine rehabilitation areas follows those described within **Section 3.4**. Fauna survey methods and survey effort for the mine rehabilitation areas are summarised in **Table B.1**. The locations of fauna surveys sites are shown in **Figure B.1**. All detailed fauna survey sites were located in mine rehabilitation areas that are currently aged between 19 and 27 years. The mine rehabilitation areas are



open Eucalyptus woodland, with *Eucalyptus tetradonta* and *Eucalyptus miniata* the predominant species. The vegetation is broadly similar to MU4 on the project site (*Eucalyptus tetradonta* and *Eucalyptus miniata* open forest with low shrub or tussock grass understorey).

**Table B.1 Fauna Survey Effort**

Survey Technique	Dates	Survey Effort
Elliot Trapping	13-16 October 2014	180 trap nights (3 sites)
Cage Trapping	13-16 October 2014	36 trap nights (3 sites)
Pitfall Trapping	13-16 October 2014	36 trap nights (3 sites)
Funnel Trapping	13-16 October 2014	36 trap nights (3 sites)
Bird Census (diurnal)	13-16 October 2014	24 surveys (8 for each of 3 sites)
Bird Census (nocturnal)	13-16 October 2014	6 surveys (2 for each of 3 sites)
Active Searches (diurnal)	13-16 October 2014	9 surveys (3 for each of 3 sites)
Active Searches (nocturnal)	13-16 October 2014	6 surveys (2 for each of 3 sites)
Ultrasonic Call Detection	13-16 October 2014	3 trap nights (3 sites)
Harp Trapping	13-16 October 2014	2 trap nights (2 nights for 1 site)
IR Camera Detection	25 May - 4 October 2014	169 trap nights (4 sites)
Habitat Assessment	13-16 October 2014	3 sites

ii. *Climatic Conditions*

The IR camera surveys encompassed the period following the wet season to the late dry season. The observed meteorological conditions (temperature and rainfall) at Groote Eylandt Airport (approximately 7 km from the project site) are presented below in **Table B.2** for the detailed fauna surveys. The weather conditions during the October 2014 survey period were characterised by warm to hot days, and cool to moderately warm nights. The entire survey period was dry. Further detail on meteorological conditions is provided in Section 3.2.4.

**Table B.2 Meteorological Conditions on Groote Eylandt during Field Surveys in Mine Rehabilitation Areas**

Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rainfall (mm)
13/10/2014	21.2	36.2	0.0
14/10/2014	22.8	33.0	0.0
15/10/2014	23.7	33.7	0.0
16/10/2014	16.6	33.6	0.0

Data obtained from the Groote Eylandt Airport (Station 014518) (BOM, 2014)





### iii. *Limitations*

The general limitations outlined in **Section 3.7.2** apply to this assessment. Detailed fauna survey sites were only undertaken at three sites in mine rehabilitation areas that are currently aged between 19 and 27 years. Further surveys across the mine rehabilitation area and across varying classifications would likely yield additional faunal assemblage data.

## **B.3 Results**

In total, 41 fauna species have been recorded from the mine rehabilitation areas during the current study, including 21 birds, 11 mammals and nine reptiles. **Figure B.2** shows the location of threatened species recorded during this field survey.

When the data from the current study is combined with the fauna species recorded by URS (2012), the mine rehabilitation areas are known to support a total of 95 fauna species, including seven amphibians, 51 birds, 14 mammals and 23 reptiles. A discussion of the faunal diversity recorded from the mine rehabilitation areas is presented below. A complete list of all the fauna species that have been recorded from the mine rehabilitation areas is presented in **Table B.3**. These results incorporate the results of previous surveys undertaken within mine rehabilitation areas by URS (2012).

### **B.3.1 Amphibians**

Seven amphibians have been recorded within the mine rehabilitation areas during current and previous surveys. Species occurring within the mine rehabilitation areas include Northern Dwarf Tree Frog (*Litoria bicolor*) and Roth's Tree Frog (*Litoria rothii*).

No threatened amphibians listed under the EPBC Act and/or the TPWC Act have been recorded from the project site or from database searches and none are considered likely to occur.

### **B.3.2 Birds**

The mine rehabilitation areas support a suite of bird species, however diversity is generally considered low due to the dominance of one broad habitat type. Fifty-one bird species have been recorded within the mine rehabilitation areas. Given the uniformity of much of the habitat within the project site, this level of bird diversity is expected.

The vast majority of bird species were common and widespread species, and typical of woodland environments. Common families within the mine rehabilitation areas include Meliphagidae (honeyeaters and friarbirds) and Columbidae (pigeons and doves). Species recorded include Peaceful Dove (*Geopelia striata*), Orange-footed Scrubfowl (*Megapodius reinwardt*), Pied Butcherbird (*Cracticus nigrogularis*), Torresian Crow (*Corvus orru*), Double-barred Finch (*Taeniopygia bichenovii*), Brown Honeyeater (*Lichmera indistincta*), Silver-crowned Friarbird (*Philemon argenticeps*), Leaden Flycatcher (*Myiagra rubecula*), Olive-backed Oriole (*Oriolus sagittatus*) and Rainbow Lorikeet (*Trichoglossus haematodus*).



No threatened species were recorded. One bird, the Rainbow Bee-eater (*Merops ornatus*), which is listed as migratory under the EPBC Act, was recorded during this field survey in mine rehabilitation. In addition, URS (2012) recorded the Marsh Sandpiper (*Tringa stagnatilis*) (as migratory under the EPBC Act) in mine rehabilitation.

### **B.3.3 Mammals**

A total of 14 mammal species have been recorded within the mine rehabilitation areas, including nine terrestrial species, two microbats and three megachiropteran bats (flying-foxes). Of the recorded mammal species, three are exotic species (see **Section 6.2.5**). Terrestrial mammals within the mine rehabilitation areas include the Northern Quoll (*Dasyurus hallucatus*), Agile Wallaby (*Macropus agilis*), Grassland Melomys (*Melomys burtoni*) and Delicate Mouse (*Pseudomys delicatulus*). One microbat, Common Sheath-tail-bat (*Taphozous georgianus*), was positively identified. Three species of flying-fox have been recorded, including the Northern Blossom-bat (*Macroglossus minimus*).

One threatened mammal, the Northern Quoll (*Dasyurus hallucatus*) has been recorded within the mine rehabilitation areas both during this field survey and by URS (2012). The Northern Quoll is listed as Endangered under the EPBC Act and Critically Endangered under the TPWC Act.

### **B.3.4 Reptiles**

A total of 23 reptile species have been recorded within the mine rehabilitation areas, including one exotic species (see **Section B.3.5**). The dominant family within the mine rehabilitation areas is Scincidae (skinks), with other families present including Varanidae (monitors/goannas). Reptiles recorded include Bynoe's Gecko (*Heteronotia binoei*), Bauxite Rainbow-skink (*Carlia amax*), Robust Ctenotus (*Ctenotus robustus*) and Spalding's Ctenotus (*Ctenotus spaldingi*).

The following threatened and/or migratory reptiles have been recorded within the mine rehabilitation areas:

- Yellow-spotted Monitor (*Varanus panoptes*); and
- Mertens' Water Monitor (*Varanus mertensi*).

These species are listed as Vulnerable under the TPWC Act.

### **B.3.5 Exotic Species**

Few exotic species were recorded during surveys of the mine rehabilitation areas. Exotic species recorded include Domestic Dogs/Dingoes (*Canis familiaris/lupus*), House Mouse (*Mus musculus*), Black Rat (*Rattus rattus*) and Asian Gecko (*Hemidactylus frenatus*).

Table B.3 Fauna Species Recorded within the Mine Rehabilitation Areas and Project Site

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria bicolor</i>	Northern Dwarf Tree Frog	-	-	X		X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria nasuta</i>	Rocket Frog	-	-			X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria pallida</i>	Pale Frog	-	-			X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria rothii</i>	Roth's Tree Frog	-	-	X		X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria rubella</i>	Desert Tree Frog	-	-	X			
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria tornieri</i>	Tornier's Frog	-	-	X			
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Crinia remota</i>	Remote Froglet	-	-			X	
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Limnodynastes convexiusculus</i>	Marbled Frog	-	-	X			
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Platyplectrum ornatum</i>	Ornate Burrowing Frog	-	-	X			
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Uperoleia inundata</i>	Floodplain Toadlet	-	-			X	
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Uperoleia lithomoda</i>	Stonemason Toadlet	-	-	X			
AVES	APODIFORMES	AEGOTHELIDAE	<i>Aegotheles cristatus</i>	Australian Owllet-nightjar	-	-			X	
AVES	CAPRIMULGIFORMES	CAPRIMULGIDAE	<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	-	-	X			
AVES	CAPRIMULGIFORMES	PODARGIDAE	<i>Podargus strigoides</i>	Tawny Frogmouth	-	-	X		X	
AVES	CHARADRIIFORMES	BURHINIDAE	<i>Burhinus grallarius</i>	Bush Stone-curlew	-	-	X		X	
AVES	CHARADRIIFORMES	CHARADRIIDAE	<i>Vanellus miles</i>	Masked Lapwing	-	-	X			

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Tringa stagnatilis</i>	Marsh Sandpiper	M(m)	-	X			
AVES	CICONIIFORMES	ARDEIDAE	<i>Egretta novaehollandiae</i>	White-faced Heron	-	-	X			X
AVES	CICONIIFORMES	ARDEIDAE	<i>Nycticorax caledonicus</i>	Nankeen Night-heron	-	-	X			X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Chalcophaps indica</i>	Emerald Dove	-	-				X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Ducula bicolor</i>	Pied Imperial-pigeon	-	-				X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Geopelia humeralis</i>	Bar-shouldered Dove	-	-	X	X		X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Geopelia striata</i>	Peaceful Dove	-	-	X	X		X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Phaps chalcoptera</i>	Common Bronzewing	-	-	X	X		X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	-	X			X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Todiramphus macleayii</i>	Forest Kingfisher	-	-	X			X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Todiramphus sanctus</i>	Sacred Kingfisher	-	-	X			
AVES	CORACIIFORMES	MEROPIIDAE	<i>Merops ornatus</i>	Rainbow Bee-eater	M (t)	-	X			X
AVES	CUCULIFORMES	CENTROPODIDAE	<i>Centropus phasianinus</i>	Pheasant Coucal	-	-	X			X
AVES	CUCULIFORMES	CUCULIDAE	<i>Cacomantis variolosus</i>	Brush Cuckoo	-	-	X			X
AVES	CUCULIFORMES	CUCULIDAE	<i>Eudynamys orientalis</i>	Eastern Koel	-	-				X
AVES	CUCULIFORMES	CUCULIDAE	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	-	-				X
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	-	-	X			

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Accipiter fasciatus</i>	Brown Goshawk	-	-	-	-	X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Aquila audax</i>	Wedge-tailed Eagle	-	-	-	-	X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Haliastur sphenurus</i>	Whistling Kite	-	-	-	X	X	
AVES	GALLIFORMES	MEGAPODIIDAE	<i>Megapodius reinwardt</i>	Orange-footed Scrubfowl	-	-	-	X	-	
AVES	GALLIFORMES	PHASIANIDAE	<i>Coturnix ypsilophora</i>	Brown Quail	-	-	-	-	X	
AVES	PASSERIFORMES	ARTAMIDAE	<i>Cracticus nigrogularis</i>	Pied Butcherbird	-	-	-	X	X	
AVES	PASSERIFORMES	ARTAMIDAE	<i>Cracticus tibicen</i>	Australian Magpie	-	-	-	X	X	
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	-	-	X	X	
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	-	-	-	X	X	
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Lalage sueurii</i>	White-winged Triller	-	-	-	X	-	
AVES	PASSERIFORMES	CORVIDAE	<i>Corvus orru</i>	Torresian Crow	-	-	-	X	X	
AVES	PASSERIFORMES	DICRURIDAE	<i>Dicrurus bracteatus</i>	Spangled Drongo	-	-	-	X	X	
AVES	PASSERIFORMES	ESTRILDIDAE	<i>Taeniopygia bichenovii</i>	Double-barred Finch	-	-	-	X	X	
AVES	PASSERIFORMES	MALURIDAE	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	-	-	-	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Conopophila albogularis</i>	Rufous-banded Honeyeater	-	-	-	X	-	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Lichmera indistincta</i>	Brown Honeyeater	-	-	-	X	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Melithreptus albogularis</i>	White-throated Honeyeater	-	-	-	X	X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Myzomela obscura</i>	Dusky Honeyeater	-	-	-		X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Philemon argenticeps</i>	Silver-crowned Friarbird	-	-	X	X	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Philemon citreogularis</i>	Little Friarbird	-	-	X	X	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Stomiopera unicolor</i>	White-gaped Honeyeater	-	-	X		X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra alecto</i>	Shining Flycatcher	-	-			X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra rubecula</i>	Leaden Flycatcher	-	-	X	X	X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra ruficollis</i>	Broad-billed Flycatcher	-	-			X	
AVES	PASSERIFORMES	NECTARINIIDAE	<i>Dicaeum hirundinaceum</i>	Mistletoebird	-	-	X		X	
AVES	PASSERIFORMES	ORIOLIDAE	<i>Oriolus flavocinctus</i>	Yellow Oriole	-	-	X			
AVES	PASSERIFORMES	ORIOLIDAE	<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	-	X	X	X	
AVES	PASSERIFORMES	ORIOLIDAE	<i>Sphecothebes vieilloti</i>	Australasian Figbird	-	-	X			
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	-	X		X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Colluricincla megarrhyncha</i>	Little Shrike-thrush	-	-		X	X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Pachycephala rufiventris</i>	Rufous Whistler	-	-	X	X	X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Pachycephala simplex</i>	Grey Whistler	-	-			X	
AVES	PASSERIFORMES	PARDALOTIDAE	<i>Pardalotus striatus</i>	Striated Pardalote	-	-	X		X	
AVES	PASSERIFORMES	PETROICIDAE	<i>Microeca flavigaster</i>	Lemon-bellied Flycatcher	-	-	X		X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
AVES	PASSERIFORMES	POMATOSTOMIDAE	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	-	X		X	
AVES	PASSERIFORMES	PTILONORHYNCHIDAE	<i>Ptilonorhynchus nuchalis</i>	Great Bowerbird	-	-	X			
AVES	PASSERIFORMES	RHIPIDURIDAE	<i>Rhipidura rufiventris</i>	Northern Fantail	-	-	X	X	X	
AVES	PSITTACIFORMES	CACATUIDAE	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	-	X	X	X	
AVES	PSITTACIFORMES	CACATUIDAE	<i>Cacatua sanguinea</i>	Little Corella	-	-	X	X		
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	-	X	X	X	
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	-	X	X	X	
AVES	STRIGIFORMES	STRIGIDAE	<i>Ninox novaeseelandiae</i>	Southern Boobook	-	-	X		X	
AVES	STRIGIFORMES	TYTONIDAE	<i>Tyto novaehollandiae kimberli</i>	Masked Owl (northern)	V	V			X	
AVES	TURNICIFORMES	TURNICIDAE	<i>Turnix castanotus</i>	Chestnut-backed Button-quail	-	-			X	
MAMMALIA	CARNIVORA	CANIDAE	<i>Canis familiaris/lupus*</i>	Domestic Dog / Dingo	-	-		X	X	
MAMMALIA	CARNIVORA	FELIDAE	<i>Felis catus*</i>	Cat	-	-			X	
MAMMALIA	CHIROPTERA	EMBALLONURIDAE	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	-			X	
MAMMALIA	CHIROPTERA	EMBALLONURIDAE	<i>Taphozous georgianus</i>	Common Sheath-tail-bat	-	-		X	X	
MAMMALIA	CHIROPTERA	HIPPOSIDERIDAE	<i>Hipposideros ater</i>	Dusky Leaf-nosed-bat	-	-			X	
MAMMALIA	CHIROPTERA	MOLOSSIDAE	<i>Chaerephon jobensis</i>	Northern Freetail-bat	-	-			X <sup>^</sup>	
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Macroglossus minimus</i>	Northern Blossom-bat	-	-		X		

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014	
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Pteropus alecto</i>	Black Flying-fox	-	-	X		X
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Pteropus scapulatus</i>	Little Red Flying-fox	-	-	X		
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-			X <sup>^</sup>
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	-	-			X
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus nigrogriseus</i> / <i>Scotorepens greyii</i>		-	-		X <sup>^</sup>	X <sup>^</sup>
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Myotis macropus</i>	Large-footed Myotis	-	-			X
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus sp.</i>		-	-			X
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus walkeri</i>	Pygmy Long-eared Bat	-	-			X
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Vespudelus caurinus</i>	Northern Cave Bat	-	-			X
MAMMALIA	DASYUROMORPHIA	DASYURIDAE	<i>Dasyurus hallucatus</i>	Northern Quoll	E	CE	X	X	X
MAMMALIA	DASYUROMORPHIA	DASYURIDAE	<i>Planigale maculata</i>	Common Planigale	-	-	X		
MAMMALIA	DIPROTODONTIA	MACROPODIDAE	<i>Macropus agilis</i>	Agile Wallaby	-	-	X	X	X
MAMMALIA	DIPROTODONTIA	MACROPODIDAE	<i>Petrogale brachyotis</i>	Short-eared Rock-wallaby	-	-			X
MAMMALIA	DIPROTODONTIA	PETAURIDAE	<i>Petaurus breviceps</i>	Sugar Glider	-	-			X
MAMMALIA	MONOTREMATA	TACHYGLOSSIDAE	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	-	-			X
MAMMALIA	PERAMELEMORPHIA	PERAMELIDAE	<i>Isodon macrourus</i>	Northern Brown Bandicoot	-	-		X	X
MAMMALIA	RODENTIA	MURIDAE	<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	V	E			X



Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
MAMMALIA	RODENTIA	MURIDAE	<i>Melomys burtoni</i>	Grassland Melomys	-	-	X	X	X	
MAMMALIA	RODENTIA	MURIDAE	<i>Mus musculus*</i>	House Mouse	-	-		X		
MAMMALIA	RODENTIA	MURIDAE	<i>Notomys aquilo</i>	Northern Hopping-mouse	V	V			X	
MAMMALIA	RODENTIA	MURIDAE	<i>Pseudomys delicatulus</i>	Delicate Mouse	-	-	X	X	X	
MAMMALIA	RODENTIA	MURIDAE	<i>Rattus rattus*</i>	Black Rat	-	-		X		
MAMMALIA	RODENTIA	MURIDAE	<i>Zyromys argurus</i>	Common Rock-rat	-	-			X	
REPTILIA	CROCODYLIA	CROCODYLIDAE	<i>Crocodylus porosus</i>	Saltwater Crocodile	M(m)	-			X	
REPTILIA	SQUAMATA	AGAMIDAE	<i>Chlamydosaurus kingii</i>	Frilled Lizard	-	-		X	X	
REPTILIA	SQUAMATA	AGAMIDAE	<i>Diporiphora bilineata</i>	Two-lined Dragon	-	-	X		X	
REPTILIA	SQUAMATA	AGAMIDAE	<i>Diporiphora magna</i>	Yellow-sided Two-line Dragon	-	-			X	
REPTILIA	SQUAMATA	AGAMIDAE	<i>Lophognathus gilberti</i>	Gilbert's Dragon	-	-	X			
REPTILIA	SQUAMATA	BOIDAE	<i>Liasis olivaceus</i>	Olive Python	-	-			X	
REPTILIA	SQUAMATA	BOIDAE	<i>Morelia spilota</i>	Diamond Python	-	-			X	
REPTILIA	SQUAMATA	COLUBRIDAE	<i>Boiga irregularis</i>	Brown Tree Snake	-	-	X		X	
REPTILIA	SQUAMATA	COLUBRIDAE	<i>Tropidonophis mairii</i>	Freshwater Snake	-	-	X			
REPTILIA	SQUAMATA	DIPLODACTYLIDAE	<i>Oedura marmorata</i>	Marbled Velvet Gecko	-	-	X			
REPTILIA	SQUAMATA	ELAPIDAE	<i>Pseudonaja nuchalis</i>	Northern Brown Snake	-	-			X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Hemidactylus frenatus*</i>	Asian Gecko	-	-	X			
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Heteronotia binoei</i>	Bynoe's Gecko	-	-	X	X	X	
REPTILIA	SQUAMATA	PYGOPODIDAE	<i>Delma borea</i>	Rusty-topped Delma	-	-	X		X	
REPTILIA	SQUAMATA	PYGOPODIDAE	<i>Lialis burtoni</i>	Burton's Snake-lizard	-	-		X	X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia amax</i>	Bauxite Rainbow-skink	-	-		X	X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia munda</i>	Shaded-litter Rainbow-skink	-	-	X		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia sexdentata</i>		-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Cryptoblepharus metallicus</i>	Metallic Snake-eyed Skink	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Cryptoblepharus plagiocephalus</i>	Péron's Snake-eyed Skink	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus arnhemensis</i>	Arnhem Land Ctenotus	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus essingtonii</i>	Port Essington Ctenotus	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus inornatus</i>	Bar-shouldered Ctenotus	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus quirinus</i>		-	-	X	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus robustus</i>	Robust Ctenotus	-	-	X	X	X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	-	X		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Eremiascincus isolepis</i>	Northern Bar-lipped Skink	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Lerista carpentariae</i>	Carpentaria Fine-lined Slider	-	-			X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Mine Rehabilitation Areas		Project Site
					EPBC Act	TPWC Act	URS (2012)	Cumberland Ecology 2014		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia alanae</i>	Alana's Menetia	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia greyii</i>	Common Dwarf Skink	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia maini</i>	Northern Dwarf Skink	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Notoscincus ornatus</i>	Ornate Soil-crevice Skink	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Proablepharus tenuis</i>	Northern Soil-crevice Skink	-	-	X		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	-	-			X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Tiliqua scincoides intermedia</i>	Northern Blue-tongue Lizard	-	-	X		X	
REPTILIA	SQUAMATA	TYPHLOPIDAE	<i>Ramphotyphlops minimus</i>	Groote Dwarf Blind Snake	-	-			X	
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus mertensi</i>	Mertens' Water Monitor	-	V		X	X	
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus panoptes</i>	Yellow-spotted Monitor	-	V	X	X	X	
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus scalaris</i>	Spotted Tree Monitor	-	-		X	X	

<sup>1</sup> Conservation Status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory [(m) = marine, (t) = terrestrial]

\* Denotes an exotic species

^ Call not positively identified.

## B.4 Discussion

The mine rehabilitation areas provide habitat for a suite of fauna species as shown in **Table B.3**. A summary of the native fauna species recorded within the mine rehabilitation areas in comparison to the project site is shown in **Table B.4**. This data indicates that the mine rehabilitation areas support habitat for 56% of the native species known to occur within the project site. A further 28 species not identified within the project site have also been recorded within the mine rehabilitation areas. Two additional exotic species, namely House Mouse (*Mus musculus*) and Black Rat (*Rattus rattus*) were also recorded within the mine rehabilitation areas.

Creation of additional mine rehabilitation areas in conjunction with ongoing management is likely to result in an increase in the faunal assemblage of mine rehabilitation areas. This is particularly the case in areas that are connected to remnant vegetation, which allows for easier migration of species across the landscape.

**Table B.4 Native Fauna Species Comparison between the Project Site and Mine Rehabilitation Areas**

Fauna Group	Total Native Fauna Species within Project Site	Project Site Native Fauna Species Recorded in Mine Rehabilitation Areas <sup>1</sup>	% of Native Fauna Known from the Project Site Within Mine Rehabilitation Areas	Additional Native Fauna Species Recorded within Mine Rehabilitation Areas	Total Fauna Species Recorded in Mine Rehabilitation Areas
Amphibians	6	2	33	5	7
Birds	54	39	72	12	51
Mammals	23	8	35	3	11
Reptiles	31	15	48	8	23
<b>TOTAL</b>	<b>114</b>	<b>64</b>	<b>56</b>	<b>28</b>	<b>92</b>

<sup>1</sup> These are species that were recorded in the project site, as well as in mine rehabilitation.



Figure B.1. Fauna Survey Locations in Areas of Existing Rehabilitation

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Coordinate System: MGA Zone 53 (GDA 94)



Figure B.2. Threatened Fauna Records in Areas of Existing Rehabilitation



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*Appendix C*

# Compliance with Survey Guidelines

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## C.1 Introduction

Flora and fauna survey guidelines have been developed by Territory and Commonwealth Governments. This section outlines how the surveys undertaken for this assessment comply with these requirements for species known or considered as having a moderate to high likelihood of occurrence. Documents considered in this assessment include:

- Northern Territory EPA (2013) Guidelines for Assessment of Impacts on Terrestrial Biodiversity;
- NRETAS (2011) Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey;
- Brocklehurst, P., Lewis, D., Napier, D., Lynch, D. (2007) Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping. Technical Report No. 02/2007D;
- SEWPaC (2011b): Survey guidelines for Australia's threatened mammals; and
- DEWHA (2010): Survey guidelines for Australia's threatened birds.

An assessment of the relevant components of these documents is provided below.

**Table C.1** and **Table C.2** summarises how the Northern Territory Requirements for flora and fauna surveys have been met.

**Table C.3** summarises how the EPBC Act fauna survey guidelines for threatened fauna relevant to the project have been met.





**Table C.1 Compliance with Northern Territory Guidelines for Flora Survey**

Category	Recommended Methods and Effort <sup>1</sup>	Current Survey Techniques and Effort
Full Characterisation Sites ("Primary Plots")	<p>Plots are commonly 20 x 20 metres with the following information recorded:</p> <ul style="list-style-type: none"> <li>• Plot location;</li> <li>• Species that occurs in each plot;</li> <li>• The stratum in which each species occurs;</li> <li>• The cover of each species present;</li> <li>• The height of each species present; and</li> <li>• The basal area for trees and shrubs.</li> </ul> <p>No detailed guidance on sampling density is provided.</p>	<p>33 primary plots were sampled in 20 x 20 metre areas and all the required information was collected from these plots.</p> <p>The cumulative number of new species levelled off by the completion of 33 primary plots, indicating that adequate survey was achieved.</p>
Check Sites ("Secondary Plots")	<p>Plots are commonly 20 x 20 metres with the following information recorded:</p> <ul style="list-style-type: none"> <li>• Plot location;</li> <li>• Two or three of the most dominant species in either the dominant or all strata/sub strata;</li> <li>• The cover of the dominant species recorded;</li> <li>• The height of the dominant species recorded; and</li> <li>• The basal area for the dominant species recorded.</li> </ul> <p>No detailed guidance on sampling density is provided.</p>	<p>23 secondary plots were sampled in 20 x 20 metre areas and all the required information was collected from these plots.</p> <p>No new species were recorded in secondary plots, indicating that adequate survey was achieved to validate the vegetation mapping.</p>
Road Notes ("Meander Transect Points and Track Notes")	<p>Cover and height estimates for two to three dominant species in either the dominant or all strata/sub strata are recorded.</p> <p>No detailed guidance on sampling density is provided.</p>	<p>544 meander transect points and track notes were sampled at changes between vegetation communities and also at regularised intervals (approximately 100 m).</p> <p>Adequate coverage of the project site was achieved to substantially validate the vegetation mapping.</p>
Threatened Species Searches	<p>No guidance is given on threatened species survey.</p>	<p>All vascular flora species found were collected and were identified to species level with the exception of some grasses (for which insufficient flowering material was available). The conservation status of all collected specimens was checked to determine whether they were listed as a threatened species.</p>

1. *From the Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping (Brocklehurst et al., 2007).*

**Table C.2 Compliance with Northern Territory Guidelines for Fauna Survey**

Category	Recommended Methods and Effort <sup>1</sup>	Current Survey Techniques and Effort
Quadrat design	All quadrats measure 50m x 50m. Quadrats are to be located within substantial areas of homogeneous vegetation and landform, except where sampling of ecotones are targeted.	18 50m x 50m quadrats set out between two sampling periods (9 quadrats in May/June, and 9 quadrats in October)
	Quadrats are to be separated by at least 500m.	All quadrats were separated by at least 500 m except sites FA5 and FA7. These sites were located closer due to unique vegetation at FA5.
	Each quadrat to consist of four cage traps, one in each corner.	Each quadrat consisted of four cage traps, one in each corner
	20 elliot traps to be placed around the perimeter, five on each side and approximately 8m apart. Elliot traps to be baited with a mixture of oats, peanut butter, and honey.	20 elliot traps were used at each of the 18 sites as recommended. Bait mix consisted of a mixture of oats, peanut butter, honey, sesame oil, and sardines.
	Four pitfall traps scattered within the quadrat. Each trap consists of a 20L plastic bucket dug into the ground with 10m of drift fence set across it to channel small ground-dwelling fauna into the bucket. Pitfalls are to be located within different microhabitats, within the quadrat.	Four pitfall traps were dug into the ground at each site. Four 20L buckets were situated along a 20m drift fence. Where suitable, the drift fence was set to intersect differing microhabitats within the site.
	Four funnel traps placed in pairs along two 10m drift fences.	Four funnel traps were placed in two pairs along drift fencing in microhabitats.
	All traps to be opened for a minimum of three nights, checked each morning and again at midday.	All traps were left open for three nights and check in the morning, around midday and in the evening.
Bird Survey	Eight diurnal bird counts to be carried out at each quadrat.	Eight diurnal instantaneous bird counts were conducted at each survey site.
	Majority of Bird surveys to be completed in the morning	All surveys were completed between 6am and 12pm
	Two nocturnal visits per site	Two nocturnal surveys were carried out at each survey site.
Active searches	Each quadrat is actively searched 5 times for reptiles, amphibians, mammals, scats and signs. Three searches during the day and two searches at night with spotlight.	Each quadrat was searched actively mid-morning on three occasions. Two night searches with spotlight were also conducted concurrently with bird searches at each site.



Category	Recommended Methods and Effort <sup>1</sup>	Current Survey Techniques and Effort
	Each search is to take approximately 15 minutes and involves turning rocks and logs, raking through leaf litter, and looking under bark and in crevices	Each site was searched for 15 minutes on each occasion.
Incidental records	Species that are seen in the vicinity of the quadrat and in the same environment are recorded as incidentals for that site	Incidental records were made as per the guideline
Bat sampling	Systematic methods for surveying bats include timed recordings using digital bat recording equipment for one or more nights per site	Song Meter SM2+ units equipped with ultrasonic microphones were used at each quadrat. Each was set out for two nights to record bat calls between dusk and dawn.
	Bat calls are to be identified by comparison with a reference library (Milne 2002)	Bat calls were identified by comparison with a reference library (Milne 2002)
	Opportunistic surveys can be conducted using harp traps and mist nets	Opportunistic harp traps were set out near FA2, FA4 and FA7 in October 2014, where suitable flyways existed.
Invertebrate Sampling	Invertebrate taxa are not routinely sampled during NRETAS biodiversity surveys (although systematic sampling of ants and some other groups effectively sampled using pit traps have sometimes been included – e.g. Andersen et al. 2002, 2004)	Invertebrate taxa were not surveyed
Habitat description	NRETAS biodiversity survey proforma to be used to record ecologically meaningful information about sampling sites	Habitat descriptions were carried out as per NRETAS biodiversity proforma. A general description of the fauna survey sites is provided in <b>Table 3.4.</b>
	Digital photographs to be taken at each site	Digital photographs were taken at each site as part of the flora survey. A representative photograph of the fauna survey sites is provided in <b>Table 3.4.</b>

1. Effort described within the Guidelines for Assessment of Impacts on Terrestrial Biodiversity (NT EPA, 2013) and Environmental Assessment Guidelines for the Northern Territory: Terrestrial Fauna Survey (NRETAS, 2011)

Table C.3 EPBC Act Listed Threatened Fauna Species Survey Requirements and Survey Compliance

Species Name	EPBC Act Status	Recommended Methods	Recommended Survey Effort	Current Survey Techniques and Effort
<b>BIRDS<sup>1</sup></b>				
Red Goshawk ( <i>Erythrotriorchis radiatus</i> )	Vulnerable	Search for their characteristic nests within patches of the tallest forest. In sub-coastal woodland, these areas can initially be identified from aerial photos and then searched during follow-up ground surveys. Further inland requires ground searches along river banks for nests within the tallest trees. Driving slowly through tropical woodland tracks and scanning groups of tall trees for nests can also be effective. In eastern Australia's ranges, searching for nests is more difficult but soaring birds can sometimes be located from vantage points such as mountain tops. Some success has been had surveying this species using call playbacks during the breeding season.	Area searches: 8 hours, 10 days.	100x100m area surveys at 18 sites (surveys conducted 8 times at each site). General observations throughout survey period, including driving along tracks.
Masked Owl (northern) ( <i>Tyto novaehollandiae kimberli</i> )	Vulnerable	Broadcast (playback) surveys effective in suitable habitat, especially in lead up to breeding season. Detection of solicited responses. Area and transect searches unlikely to be useful due to nocturnal habits and cryptic nature. May also be attracted by squeaky noises.	Broadcast surveys: 8 hours, 4 days.	Broadcast surveys (call playback) at 18 sites (surveys conducted 2 times at each site).
Partridge Pigeon (eastern) ( <i>Geophaps smithii smithii</i> )	Vulnerable	Area searches or transect surveys of suitable habitat with detection by flushing or call. Flushing surveys with groups of people walking in a line through savannah is a useful technique and has been used in areas of Kakadu National Park during early dry season. Also targeted searches and subsequent watches of waterholes for presence in late dry season.	Area searches or transect surveys: 20 hours, 5 days. Flushing surveys: 15 hours, 5 days. Targeted searches: 20 hours, 10 days.	100x100m area surveys at 18 sites (surveys conducted 8 times at each site). Use of three IR cameras at two locations viewing water during the October 2014 survey (total of 41 trap nights).



Species Name	EPBC Act Status	Recommended Methods	Recommended Survey Effort	Current Survey Techniques and Effort
Gouldian Finch ( <i>Erythrura gouldiae</i> )	Endangered	Targeted searches and watches at waterholes late in the dry season. Also check for association with breeding black-faced wood swallows <i>Artamus cinereus</i> in early wet season. Area searches in suitable habitat may also be useful.	Targeted searches: 12 hours, 4 days Area searches: 20 hours, 5 days	100x100m area surveys at 18 sites (surveys conducted 8 times at each site) Use of three IR cameras at two locations viewing water during the October 2014 survey (total of 41 trap nights).
<b>MAMMALS<sup>2</sup></b>				
Brush-tailed Rabbit-rat ( <i>Conilurus penicillatus</i> )	Vulnerable	On the basis of previous surveys, the following survey techniques are recommended to detect the presence of the Brush-tailed Rabbit-rat in areas up to 5 hectares in size: <ul style="list-style-type: none"> <li>• daytime searches for potentially suitable habitat resources such as open forest with taller trees, less frequent (or less intense) fires, sparse grass cover, and distance from watercourses or moist areas</li> <li>• trapping surveys using Elliott traps and cage traps are the best techniques for targeted surveys of this species</li> <li>• spotlight surveys.</li> </ul>	20 Elliott traps, or 10 cage traps per sampling site. Traps placed on the ground approximately 50m apart in two parallel straight lines separated by 20-50m. Traps to be set for minimum of three nights in the Northern Territory. One sampling site per representative habitat, with a minimum of two sampling sites per 5 hectares. For areas greater than 5	20 Elliott traps 18 sites for three nights each (total 1,080 trapping nights). IR camera traps were set at 22 sites for a total of 814 trap nights.

Species Name	EPBC Act Status	Recommended Methods	Recommended Survey Effort	Current Survey Techniques and Effort
Northern Quoll ( <i>Dasyurus hallucatus</i> )	Endangered	On the basis of previous surveys, the survey techniques recommended to detect the presence of the northern quoll in areas up to 5 hectares in size are cage trapping and Elliott trapping surveys. Trapping is best conducted between May and August to minimise possible disturbance during the reproductive period. Trapping should be concentrated in rocky denning habitat, with some consideration of non-rocky foraging and dispersal habitats. Additional or complementary techniques to locate northern quolls that are not commonly reported in the literature include daytime searches of habitat, and latrine sites, sand traps, remote cameras and hair tubes, spotlighting.	hectares, replication between representative sampling sites will be required and distance between traps increased, but specifications will be dependent on the project and nature of the subject site.  20 Elliott traps, or 10 cage traps per sampling site.  Traps placed on the ground approximately 50m apart in two parallel straight lines separated by 20-50m.  Traps to be set for minimum of three nights in the Northern Territory.  One sampling site per representative habitat, with a minimum of two sampling sites per 5 hectares.  For areas greater than 5 hectares, replication between representative sampling sites will be required and distance between traps increased, but	20 Elliott traps and 4 cage traps at 18 sites for three nights each (total 1,296 trap nights).  IR camera traps were set at 22 sites for a total of 813 trap nights.  Spotlighting surveys were also conducted.



Species Name	EPBC Act Status	Recommended Methods	Recommended Survey Effort	Current Survey Techniques and Effort
Northern Hopping-mouse ( <i>Notomys aquilo</i> )	Vulnerable	<p>On the basis of previous surveys, the following survey techniques are recommended to detect the presence of the Northern Hopping-mouse in areas up to 5 hectares in size:</p> <ul style="list-style-type: none"> <li>• daytime searches for potentially suitable habitat resources, including but not limited to sand dune habitats</li> <li>• daytime searches for signs, particularly the distinctive associated spoil mounds and tracks following the protocol outlined by Ward (2009), where these searches are carried out over 200 metre long transects</li> <li>• collection of predator scats, owl casts or remains in predatory bird/mammal nests/dens</li> <li>• spotlight surveys on foot or from a moving vehicle</li> <li>• pitfall trap surveys (as for other <i>Notomys</i> capture rates can be improved by using narrow PVC pipe rather than wider buckets, with a diameter of 16 centimetres and trap depth recommended to be at least 60 centimetres)</li> <li>• use sand pads on non-sand substrate where this species is suspected to occur</li> <li>• consultation with local people, particularly investigating potential Indigenous knowledge of this species' presence in an area</li> <li>• consider the placement of baited camera traps (same as for predator pads) in suitable habitat, concentrating on well-used runway areas (as told from the number of tracks), particularly as this species can be relatively easily</li> </ul>	<p>specifications will be dependent on the project and nature of the subject site.</p> <p>Daytime searches for suitable habitat resources is recommended at up to 2 hours search per site per 5 hectare area.</p> <p>Predator scats are collected opportunistically.</p> <p>Spotlighting surveys suggested to consist of two 200m surveys per 5ha area on foot, or vehicle surveys at a rate of 10m per minute.</p> <p>Pitfall trapping at a rate of ten pitfall traps in a straight line at 10 m intervals along a 120m drift fence. Traps to be set at two sampling sites per 5 hectares over a period of four nights.</p> <p>IR camera traps were set out at each site at a rate of 10 cameras per hectare for</p>	<p>Diurnal habitat searches were conducted at 18 sites. Five searches (3 diurnal and 2 nocturnal) were conducted for a period of 30 minutes per site.</p> <p>Spotlighting was undertaken at each site for a minimum period of 15 minutes at each site, over two nights.</p> <p>Four pitfall traps were set out at 18 sites for 3 nights (216 trap nights).</p> <p>IR camera traps were set at 22 sites for a total of 814 trap nights.</p> <p>Anindilyakwa Land Council (ALC) rangers were involved in surveys within the project site. The</p>

Species Name	EPBC Act Status	Recommended Methods	Recommended Survey Effort	Current Survey Techniques and Effort
Water Mouse ( <i>Xeromys myoides</i> )	Vulnerable	<p>separated from other sympatric species.</p> <p>Daytime searches should include transect style searches spaced at 50–100m intervals, or in quadrats, and involve one to two hours spent looking for nesting structures for every one hectare of intertidal or supralittoral water mouse habitat.</p> <p>Elliott trapping (Size A) must be carried out at night. Elliott trapping is the only reliable method for estimating water mouse population density. Elliott traps should be baited with pilchards cut in half, mullet pieces or commercial cat food. The minimum survey effort required to trap the water mouse is 400 trap nights per four to five hectares of potential water mouse habitat.</p> <p>Pitfall trapping, spotlighting and hair tubing can be used to increase the probability of detecting the water mouse. However, these techniques are not required where primary techniques are implemented.</p>	<p>minimum 14 nights.</p>	<p>literature review also included review of ALC ranger reports.</p> <p>20 Elliott traps at 18 sites for three nights each (total 1,080 trapping nights).</p> <p>Four pitfall traps were set out at 18 sites for 3 nights (216 trap nights).</p> <p>Spotlighting was undertaken at each site for a minimum period of 15 minutes at each site, over two nights.</p> <p>Use of three IR cameras at two locations viewing water during the October 2014 survey (total of 41 trap nights).</p>
<b>REPTILES<sup>3</sup></b>				
Plains Death Adder ( <i>Acanthopis hawkei</i> )	Vulnerable	<p>None prescribed as species was listed after the survey guidelines were developed. National standard survey methods for reptiles including diurnal and nocturnal active searches, spotlighting, pit and funnel traps were used. Additionally, remote infra-red cameras were utilised.</p>	<p>None prescribed.</p>	<p>Four pitfall traps were set out at 18 sites for 3 nights (216 trap nights).</p> <p>Four funnel traps were set</p>





Species Name	EPBC Act Status	Recommended Methods	Recommended Survey Effort	Current Survey Techniques and Effort
				out at 18 sites for 3 nights (216 trap nights). Spotlighting was undertaken at each site for a minimum period of 15 minutes at each site, over two nights. IR camera traps were set at 22 sites for a total of 814 trap nights. Diurnal habitat searches were conducted at 18 sites for a period of 30 minutes per site.

*Recommended Survey Method and Effort derived from:*

1. Survey guidelines for Australia's threatened birds (DEWHA, 2010)
2. Survey guidelines for Australia's threatened mammals (SEWPaC, 2011b)
3. Survey guidelines for Australia's threatened reptiles (SEWPaC, 2011c). Note that the Plains Death Adder was listed after the publication of this guideline and so general methods from this guideline were adopted in field surveys.



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*Appendix D*

EPBC Act Protected Matters Search Tool  
Results

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## EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 01/07/14 10:17:25

[Summary](#)

[Details](#)

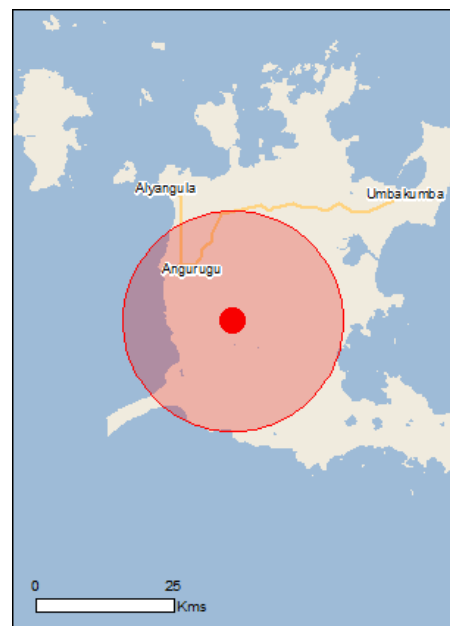
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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[Coordinates](#)

Buffer: 20.0Km



## Summary

### Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	1
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Areas:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	None
<a href="#">Listed Threatened Species:</a>	18
<a href="#">Listed Migratory Species:</a>	28

### Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

<a href="#">Commonwealth Land:</a>	None
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	60
<a href="#">Whales and Other Cetaceans:</a>	11
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Commonwealth Reserves Marine:</a>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">Place on the RNE:</a>	4
<a href="#">State and Territory Reserves:</a>	1
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	3
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	None

## Details

### Matters of National Environmental Significance

National Heritage Properties		[ Resource Information ]
Name	State	Status
<b>Indigenous</b>		
<a href="#">Saltwater Country of the Groote Eylandt Archipelago</a>	NT	Nominated place

Listed Threatened Species		[ Resource Information ]
Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Erythrotriorchis radiatus</a> Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
<b>Mammals</b>		
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat may occur within area
<a href="#">Conilurus penicillatus</a> Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area
<a href="#">Dasyurus hallucatus</a> Northern Quoll [331]	Endangered	Species or species habitat known to occur within area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
<a href="#">Notomys aquilo</a> Northern Hopping-mouse, Woorentinta [123]	Vulnerable	Species or species habitat may occur within area
<a href="#">Xeromys myoides</a> Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
<b>Reptiles</b>		
<a href="#">Acanthophis hawkei</a> Plains Death Adder [83821]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Breeding known to occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
<a href="#">Eretmochelys imbricata</a> Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
<a href="#">Lepidochelys olivacea</a> Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
<b>Sharks</b>		
<a href="#">Carcharodon carcharias</a> Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
<a href="#">Pristis clavata</a> Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Pristis zijsron</a> Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
<a href="#">Rhincodon typus</a> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
<b>Listed Migratory Species</b>		<b>[ Resource Information ]</b>
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
<b>Migratory Marine Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Calonectris leucomelas</a> Streaked Shearwater [1077]		Species or species habitat may occur within area
<a href="#">Puffinus leucomelas</a> Streaked Shearwater [66541]		Species or species habitat may occur within area
<b>Migratory Marine Species</b>		
<a href="#">Balaenoptera edeni</a> Bryde's Whale [35]		Species or species habitat may occur within area
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat may occur within area
<a href="#">Carcharodon carcharias</a> Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
<a href="#">Crocodylus porosus</a> Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
<a href="#">Dugong dugon</a> Dugong [28]		Species or species habitat known to occur within area
<a href="#">Eretmochelys imbricata</a> Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
<a href="#">Lepidochelys olivacea</a> Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Manta birostris</a> Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
<a href="#">Orcaella brevirostris</a> Irrawaddy Dolphin [45]		Species or species habitat likely to occur within area
<a href="#">Orcinus orca</a> Killer Whale, Orca [46]		Species or species habitat may occur within area
<a href="#">Rhincodon typus</a> Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
<a href="#">Sousa chinensis</a> Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
<b>Migratory Terrestrial Species</b>		
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
<a href="#">Hirundo rustica</a> Barn Swallow [662]		Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat known to occur within area
<b>Migratory Wetlands Species</b>		
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat known to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Charadrius veredus</a> Oriental Plover, Oriental Dotterel [882]		Species or species

Name	Threatened	Type of Presence
<a href="#">Glareola maldivarum</a> Oriental Pratincole [840]		habitat may occur within area  Species or species habitat may occur within area

### Other Matters Protected by the EPBC Act

Listed Marine Species	[ Resource Information ]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	Type of Presence
<b>Birds</b>	
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]	Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]	Species or species habitat known to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]	Species or species habitat may occur within area
<a href="#">Calonectris leucomelas</a> Streaked Shearwater [1077]	Species or species habitat may occur within area
<a href="#">Charadrius veredus</a> Oriental Plover, Oriental Dotterel [882]	Species or species habitat may occur within area
<a href="#">Glareola maldivarum</a> Oriental Pratincole [840]	Species or species habitat may occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]	Species or species habitat known to occur within area
<a href="#">Hirundo rustica</a> Barn Swallow [662]	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]	Species or species habitat may occur within area
<a href="#">Pandion haliaetus</a> Osprey [952]	Species or species habitat known to occur within area



Name	Threatened	Type of Presence
<a href="#">Rhipidura rufifrons</a> Rufous Fantail [592]		Species or species habitat known to occur within area
<a href="#">Sterna bergii</a> Crested Tern [816]		Breeding likely to occur within area
<b>Fish</b>		
<a href="#">Campichthys tricarinatus</a> Three-keel Pipefish [66192]		Species or species habitat may occur within area
<a href="#">Choeroichthys brachysoma</a> Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
<a href="#">Choeroichthys suillus</a> Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
<a href="#">Corythoichthys amplexus</a> Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
<a href="#">Corythoichthys flavofasciatus</a> Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
<a href="#">Doryrhamphus excisus</a> Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
<a href="#">Doryrhamphus janssi</a> Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
<a href="#">Festucalex cinctus</a> Girdled Pipefish [66214]		Species or species habitat may occur within area
<a href="#">Halicampus brocki</a> Brock's Pipefish [66219]		Species or species habitat may occur within area
<a href="#">Halicampus grayi</a> Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
<a href="#">Halicampus spinirostris</a> Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
<a href="#">Haliichthys taeniophorus</a> Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
<a href="#">Hippichthys cyanospilos</a> Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
<a href="#">Hippichthys penicillus</a> Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
<a href="#">Hippocampus histrix</a> Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
<a href="#">Hippocampus kuda</a> Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
<a href="#">Hippocampus planifrons</a> Flat-face Seahorse [66238]		Species or species habitat may occur within area
<a href="#">Hippocampus spinosissimus</a> Hedgehog Seahorse [66239]		Species or species habitat may occur within area
<a href="#">Micrognathus micronotopterus</a> Tidepool Pipefish [66255]		Species or species habitat may occur within area
<a href="#">Solegnathus hardwickii</a> Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
<a href="#">Trachyrhamphus bicoarctatus</a> Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
<a href="#">Trachyrhamphus longirostris</a> Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
<b>Mammals</b>		
<a href="#">Dugong dugon</a> Dugong [28]		Species or species habitat known to occur within area
<b>Reptiles</b>		
<a href="#">Acalyptophis peronii</a> Horned Seasnake [1114]		Species or species habitat may occur within area
<a href="#">Aipysurus duboisii</a> Dubois' Seasnake [1116]		Species or species habitat may occur within area
<a href="#">Aipysurus eydouxii</a> Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
<a href="#">Aipysurus laevis</a> Olive Seasnake [1120]		Species or species habitat may occur within area
<a href="#">Astrotia stokesii</a> Stokes' Seasnake [1122]		Species or species habitat may occur within area
<a href="#">Caretta caretta</a> Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
<a href="#">Chelonia mydas</a> Green Turtle [1765]	Vulnerable	Breeding known to occur within area
<a href="#">Crocodylus porosus</a> Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
<a href="#">Dermochelys coriacea</a> Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
<a href="#">Disteira kingii</a> Spectacled Seasnake [1123]		Species or species habitat may occur within area
<a href="#">Disteira major</a> Olive-headed Seasnake [1124]		Species or species habitat may occur within area
<a href="#">Enhydrina schistosa</a> Beaked Seasnake [1126]		Species or species

Name	Threatened	Type of Presence
<a href="#">Eretmochelys imbricata</a> Hawksbill Turtle [1766]	Vulnerable	habitat may occur within area Breeding known to occur within area
<a href="#">Hydrelaps darwiniensis</a> Black-ringed Seasnake [1100]		Species or species habitat may occur within area
<a href="#">Hydrophis atriceps</a> Black-headed Seasnake [1101]		Species or species habitat may occur within area
<a href="#">Hydrophis elegans</a> Elegant Seasnake [1104]		Species or species habitat may occur within area
<a href="#">Hydrophis inornatus</a> Plain Seasnake [1107]		Species or species habitat may occur within area
<a href="#">Hydrophis mcdowelli</a> null [25926]		Species or species habitat may occur within area
<a href="#">Hydrophis ornatus</a> Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
<a href="#">Hydrophis pacificus</a> Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
<a href="#">Lapemis hardwickii</a> Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
<a href="#">Lepidochelys olivacea</a> Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
<a href="#">Natator depressus</a> Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
<a href="#">Parahydrophis mertoni</a> Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
<a href="#">Pelamis platurus</a> Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area
<b>Whales and other Cetaceans</b>		<b>[ Resource Information ]</b>
Name	Status	Type of Presence
<b>Mammals</b>		
<a href="#">Balaenoptera edeni</a> Bryde's Whale [35]		Species or species habitat may occur within area
<a href="#">Balaenoptera musculus</a> Blue Whale [36]	Endangered	Species or species habitat may occur within area
<a href="#">Delphinus delphis</a> Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
<a href="#">Grampus griseus</a> Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area

Name	Status	Type of Presence
<a href="#">Megaptera novaeangliae</a> Humpback Whale [38]	Vulnerable	Species or species habitat may occur within area
<a href="#">Orcaella brevirostris</a> Irrawaddy Dolphin [45]		Species or species habitat likely to occur within area
<a href="#">Orcinus orca</a> Killer Whale, Orca [46]		Species or species habitat may occur within area
<a href="#">Sousa chinensis</a> Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
<a href="#">Stenella attenuata</a> Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
<a href="#">Tursiops aduncus</a> Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
<a href="#">Tursiops truncatus s. str.</a> Bottlenose Dolphin [68417]		Species or species habitat may occur within area

## Extra Information

### Places on the RNE [\[ Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
<b>Indigenous</b>		
<a href="#">Angurugu Mission Group</a>	NT	Registered
<b>Historic</b>		
<a href="#">Emerald River Cemetery</a>	NT	Indicative Place
<a href="#">Emerald River Mission</a>	NT	Indicative Place
<a href="#">Emerald River Sawmill Site</a>	NT	Indicative Place

### State and Territory Reserves [\[ Resource Information \]](#)

Name	State
Anindilyakwa	NT

### Invasive Species [\[ Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
<b>Mammals</b>		
<a href="#">Felis catus</a> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
<a href="#">Rattus rattus</a> Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
<b>Reptiles</b>		

Name	Status	Type of Presence
<a href="#">Hemidactylus frenatus</a> Asian House Gecko [1708]		Species or species habitat likely to occur within area

## Coordinates

-14.06183 136.52912

## Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

## Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- [Natural history museums of Australia](#)
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



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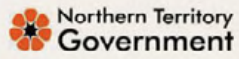
*Appendix E*

# InfoNet Search Results

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# Custom area

## *NT NRM Report*



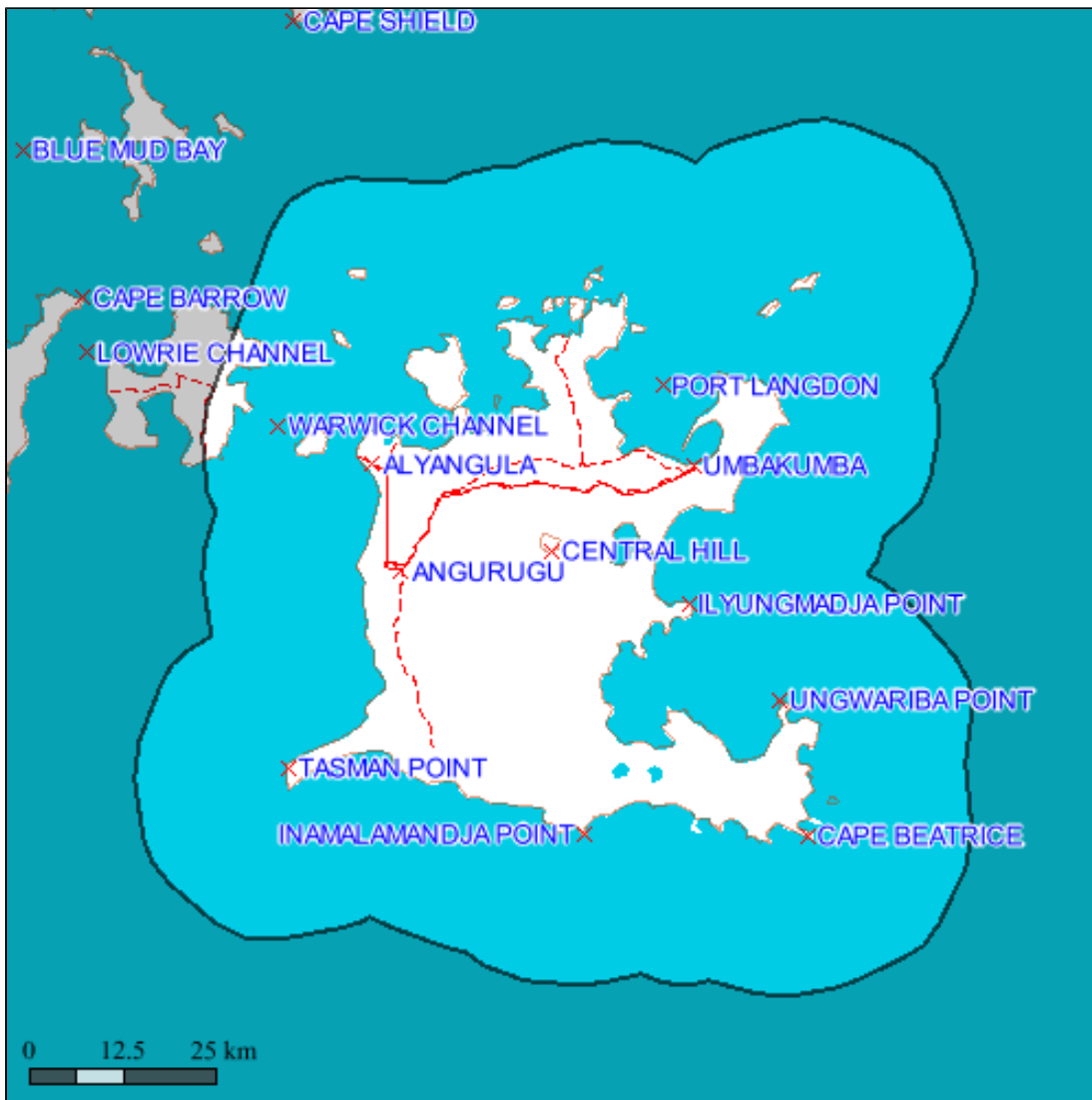
## Custom area

Custom area encompasses an area of 10230.23 sq km extending from 13 deg 26.0 min to 14 deg 29.0 min S and 136 deg 8.0 min to 137 deg 8.0 min E.

Custom area is located in the Arnhem Coast, bioregion(s)



Location of Custom area



# Custom area Climate

The closest long-term weather station is ANGURUGU (13 deg 59.0 min S, 136.4333E) 23 km W of the center of selected area

### Statistics

Mean max temp (deg C)  
 Mean min temp (deg C)  
 Average rainfall (mm)  
 Average days of rain

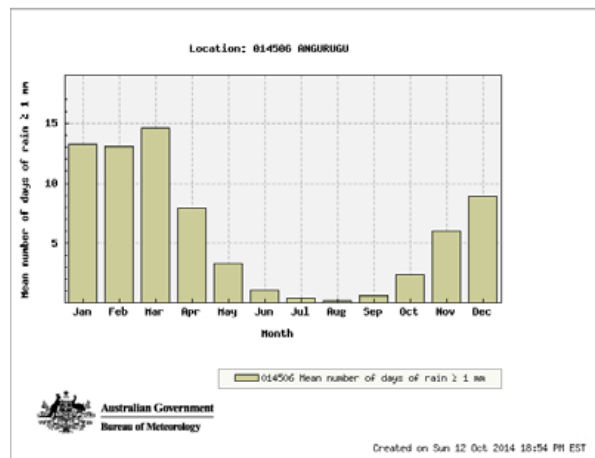
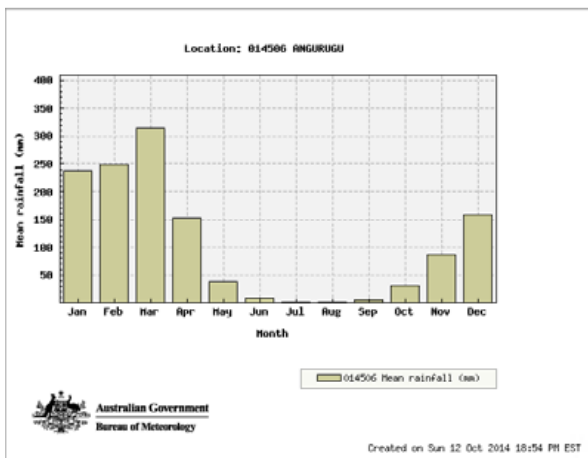
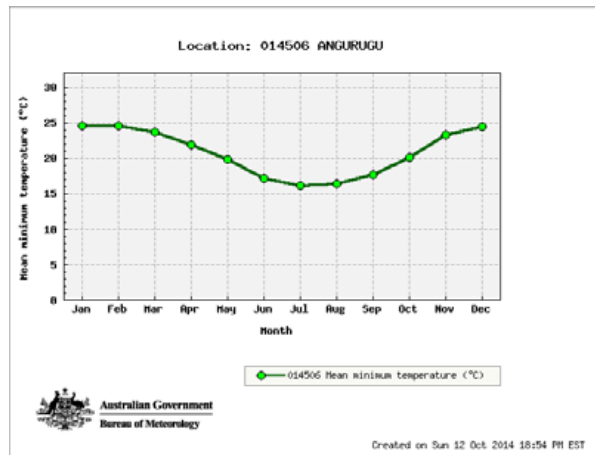
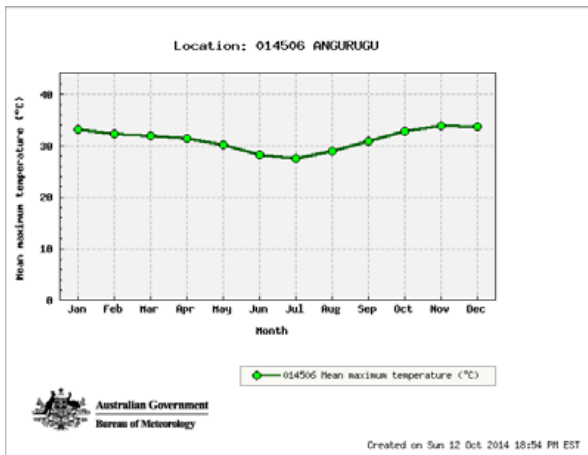
### Annual Values

31.3  
 20.8  
 1287.8  
 71.7

### Years of record

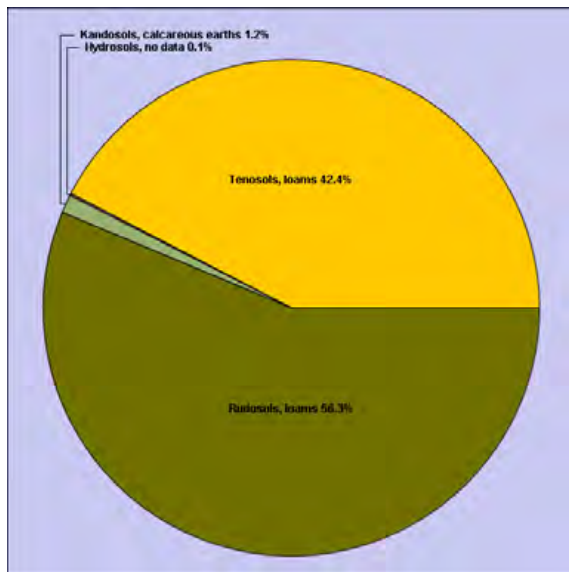
37  
 36  
 68  
 67

Climate summaries from Bureau of Meteorology ([www.bom.gov.au](http://www.bom.gov.au))



## Custom area Soils

### Soil Types



### Area of soil types (Northcote Factual Key)

Category	Area sq km	Area%
Rudosols, loams	1351.25	13.21
Tenosols, loams	1018.24	9.95
Kandosols, calcareous earths	29.54	.29
Hydrosols, no data	2.46	.02

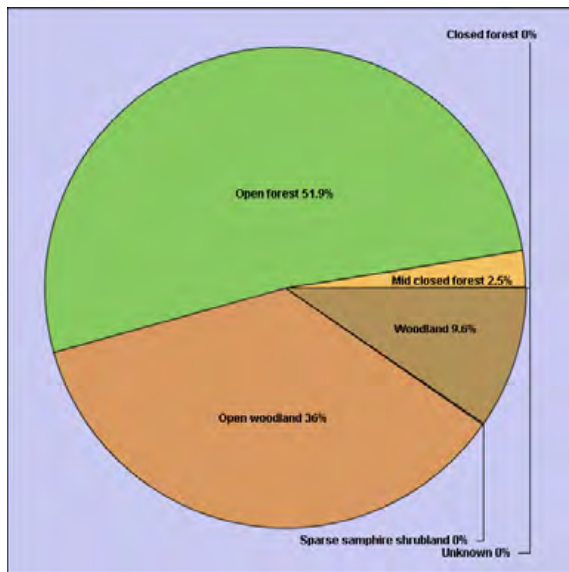
### Soil Types



Soils 1:2M Layer is a copy of the NT portion (1:2,000,000 scale dataset) of the CSIRO Atlas of Australian Soils - K.H. Northcote et al. Data scale: 1:2,000,000 ANZLIC Identifier: 2DBC771205D06B6E040CD9B0F274EFE  
 More details: Go to [www.lrm.nt.gov.au/nrmmapsnt/](http://www.lrm.nt.gov.au/nrmmapsnt/) and enter the ANZLIC identifier in the Spatial Data Search

# Custom area Vegetation

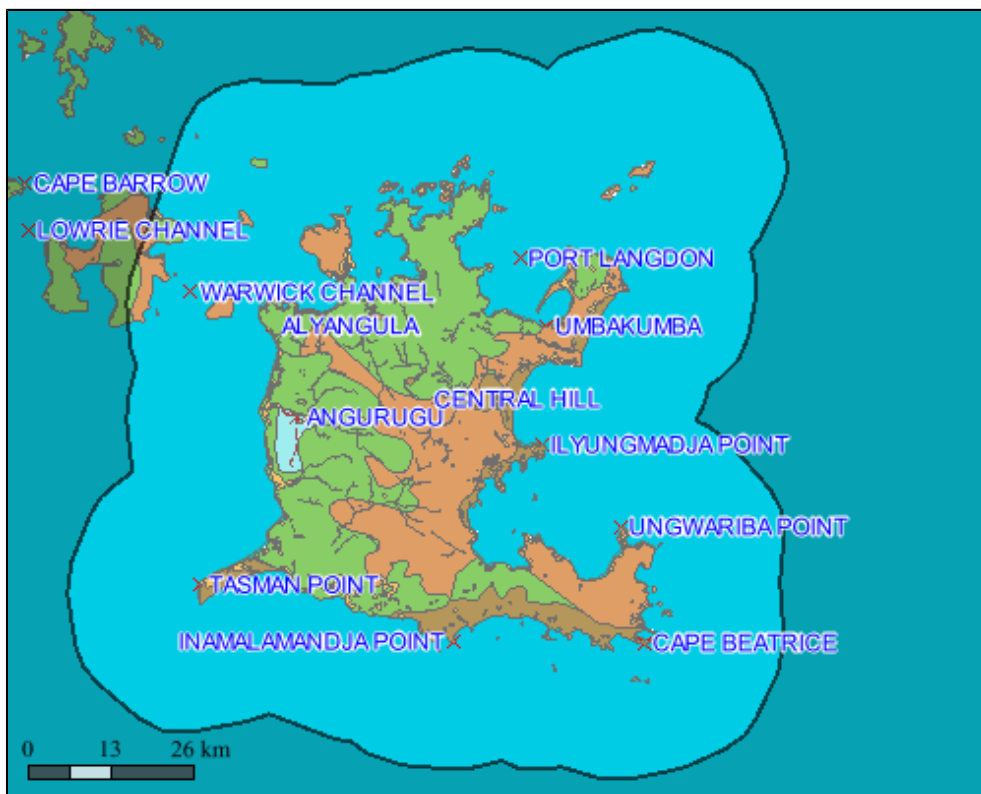
## Vegetation Communities



## Area of vegetation communities

Category	Area sq km	Area%
Open forest	1155.16	11.29
Open woodland	802.41	7.84
Woodland	213.60	2.09
Mid closed forest	55.43	.54
Sparse samphire shrubland	.84	.01
Closed forest	.19	.00
Unknown	.08	.00

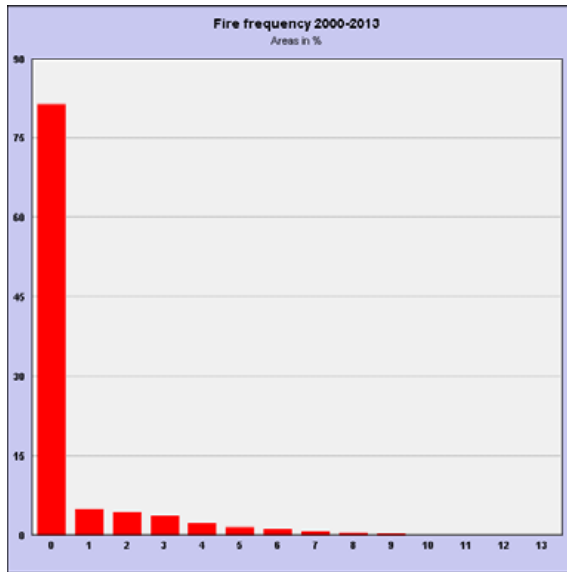
## Vegetation Communities



The NVIS 2005 Layer is compiled from a number of vegetation and land unit survey maps that were recoded and re-attributed for the National Vegetation Information System (NVIS)  
 Data scale variable depending on location. ANZLIC Identifier:2DBC771207006B6E040CD9B0F274EFE  
 More details:Go to [www.lrm.nt.gov.au/nrm/apsnt/](http://www.lrm.nt.gov.au/nrm/apsnt/) and enter the ANZLIC identifier in the Spatial Data Search

# Custom area Fire History

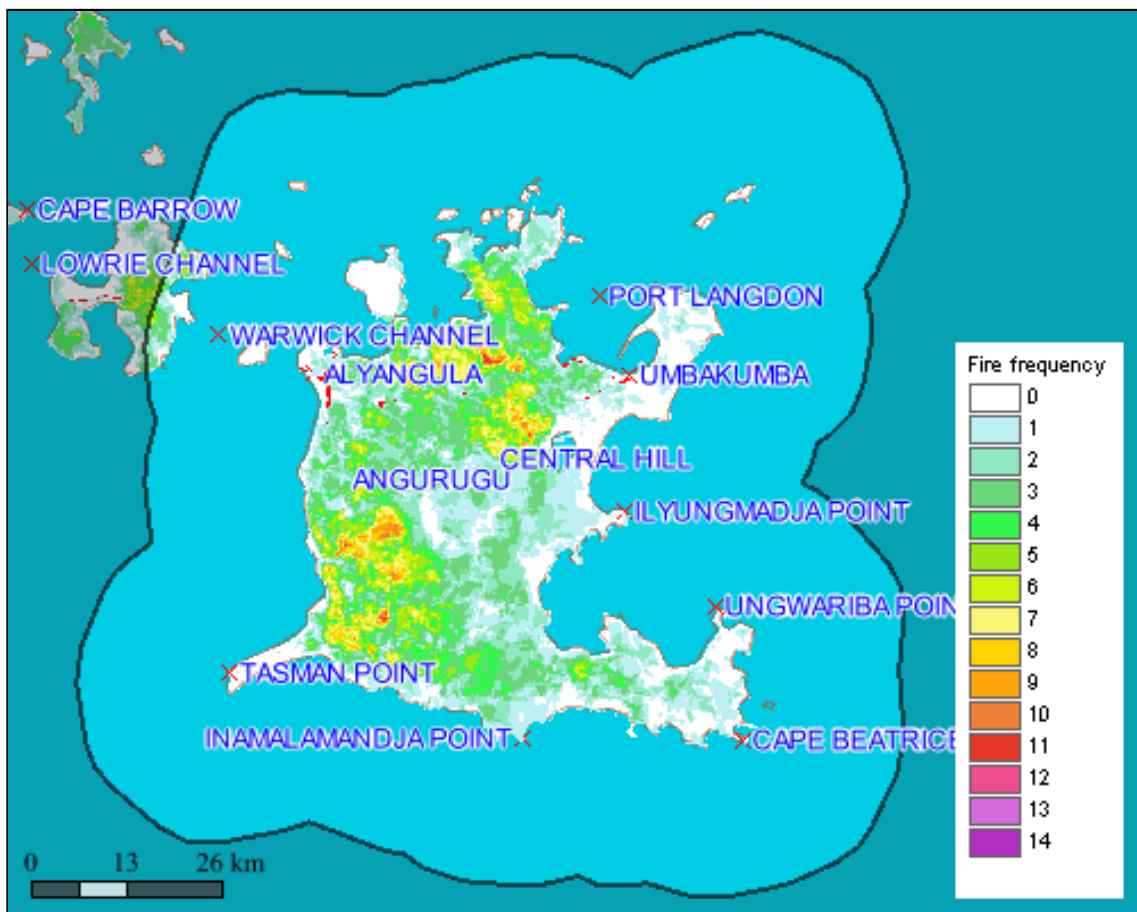
Years burnt 2000-2013



and area burnt in each category

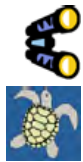
Category	Area sq km	Area%
0	8334.58	81.47
1	492.34	4.81
2	434.81	4.25
3	373.30	3.65
4	222.64	2.18
5	149.55	1.46
6	102.83	1.01
7	67.26	.66
8	28.71	.28
9	14.28	.14
10	7.44	.07
11	2.03	.02
12	.38	.00
13	.08	.00

Years burnt 2000-2013



The fire frequency(250m) Layer is derived from satellite imagery sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite  
 Spatial Resolution: 250m x 250m pixels (at Nadir).

# Custom area Threatened Species



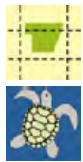
Threatened species recorded in Custom area (Records Updated: Sept 2013)

Group	Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Flowering Plants	Lantern Tree	<i>Hernandia nymphaeifolia</i>	VU	.	253736	0 (Unknown)		0 (Unknown)
Reptiles	Green Turtle	<i>Chelonia mydas</i>	.	VU	176291	213 (2006)	2 (1988)	0 (Unknown)
Reptiles	Hawksbill Turtle	<i>Eretmochelys imbricata</i>	VU	VU	176298	133 (2006)	3 (Unknown)	0 (Unknown)
Reptiles	Olive Ridley	<i>Lepidochelys olivacea</i>	VU	EN	176305	5 (1994)	15 (1979)	0 (Unknown)
Reptiles	Flatback Turtle	<i>Natator depressus</i>	.	VU	176284	185 (2006)	10 (1979)	0 (Unknown)
Reptiles	Mertens' Water Monitor	<i>Varanus mertensi</i>	VU	.	347295	6 (2008)	4 (2006)	0 (Unknown)
Reptiles	Yellow-spotted Monitor	<i>Varanus panoptes</i>	VU	.	347307	1 (2006)	4 (1982)	3 (2009)
Birds	Partridge Pigeon	<i>Geophaps smithii</i>	VU	VU	176384	0 (Unknown)	3 (1976)	2 (2006)
Birds	Lesser Sand Plover	<i>Charadrius mongolus</i>	VU	.	.	6 (1997)	3 (Unknown)	0 (Unknown)
Birds	Greater Sand Plover	<i>Charadrius leschenaultii</i>	VU	.	.	4 (1979)	0 (Unknown)	0 (Unknown)
Birds	Bar-tailed Godwit	<i>Limosa lapponica</i>	VU	.	.	6 (1996)	0 (Unknown)	0 (Unknown)
Birds	Eastern Curlew	<i>Numerius madagascariensis</i>	VU	.	.	19 (2006)	1 (1922)	0 (Unknown)
Birds	Great Knot	<i>Calidris tenuirostris</i>	VU	.	.	3 (1998)	0 (Unknown)	0 (Unknown)
Birds	Red Knot	<i>Calidris canutus</i>	VU	.	.	2 (1979)	0 (Unknown)	0 (Unknown)
Birds	Curlew Sandpiper	<i>Calidris ferruginea</i>	VU	.	.	6 (1996)	0 (Unknown)	0 (Unknown)
Birds	Gouldian Finch	<i>Erythrura gouldiae</i>	VU	EN	176370	1 (1925)	0 (Unknown)	0 (Unknown)
Mammals	Northern Quoll	<i>Dasyurus hallucatus</i>	CR	EN	176443	32 (2007)	19 (1992)	36 (2009)
Mammals	Brush-tailed Rabbit-rat	<i>Conilurus penicillatus</i>	EN	VU	176414	6 (2007)	18 (1969)	1 (2005)
Mammals	Northern Hopping-mouse	<i>Notomys aquilo</i>	VU	VU	176436	55 (2007)	41 (2006)	3 (2009)
Mammals	Pale Field-rat	<i>Rattus tunneyi</i>	VU	.	.	0 (Unknown)	1 (1972)	0 (Unknown)

EX = Extinct  
 EW = Extinct in the Wild  
 ER = Extinct in the NT  
 EN = Endangered  
 EN/WU = One Endangered subspecies/One Vulnerable subspecies  
 VU = Vulnerable  
 VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology  
 Specimen = this category refers to museum or other records where a specimen has been collected and lodged  
 Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.  
 More species info: Go to [www.landmanager.org.au/view/index.aspx?id=####](http://www.landmanager.org.au/view/index.aspx?id=####)  
 where #### is the ID number from the tables above for the species of interest.

# Custom area Threatened Species Grid



Threatened species recorded in the grid cell(s) in which Custom area occurs (Records Updated: Sept 2013)

Group	Family Name	Scientific Name	Common Name	NT Status	National Status	#Observations	Latest Observation Date	#Specimens	Latest Specimen Date	#Surveys	Latest Survey Record
Flowering Plants	Hernandiaceae	<i>Hernandia nymphaeifolia</i>	Lantern Tree	VU		0	Unknown	2	1988	0	Unknown
Reptiles	Cheloniidae	<i>Chelonia mydas</i>	Green Turtle	VU	VU	283	2006	3	Unknown	0	Unknown
Reptiles	Cheloniidae	<i>Eretmochelys imbricata</i>	Hawksbill Turtle	VU	VU	134	2006	15	1979	0	Unknown
Reptiles	Cheloniidae	<i>Lepidochelys olivacea</i>	Olive Ridley	VU	EN	8	1994	10	1979	0	Unknown
Reptiles	Cheloniidae	<i>Natator depressus</i>	Flatback Turtle	VU	VU	236	2006	8	2006	0	Unknown
Reptiles	Varanidae	<i>Varanus mertensi</i>	Mertens' Water Monitor	VU		6	2008	4	1982	3	2009
Reptiles	Varanidae	<i>Varanus panoptes</i>	Yellow-spotted Monitor	VU		1	2006	3	1976	6	2008
Birds	Columbidae	<i>Geopheaps smithii</i>	Partridge Pigeon	VU	VU	0	Unknown	3	Unknown	0	Unknown
Birds	Charadriidae	<i>Charadrius mongolus</i>	Lesser Sand Plover	VU		7	1998	0	Unknown	0	Unknown
Birds	Charadriidae	<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU		4	1979	0	Unknown	0	Unknown
Birds	Scolopacidae	<i>Limosa lapponica</i>	Bar-tailed Godwit	VU		18	1996	1	1922	0	Unknown
Birds	Scolopacidae	<i>Numenius madagascariensis</i>	Eastern Curlew	VU		24	2006	0	Unknown	0	Unknown
Birds	Scolopacidae	<i>Calidris tenuirostris</i>	Great Knot	VU		3	1998	0	Unknown	0	Unknown
Birds	Scolopacidae	<i>Calidris canutus</i>	Red Knot	VU		2	1979	0	Unknown	0	Unknown
Birds	Scolopacidae	<i>Calidris ferruginea</i>	Curlew Sandpiper	VU		7	1998	0	Unknown	0	Unknown
Birds	Estrilidae	<i>Erythrura gouldi</i>	Gouldian Finch	VU	EN	2	1971	0	Unknown	0	Unknown
Mammals	Dasyuridae	<i>Dasyurus hallucatus</i>	Northern Quoll	CR	EN	32	2007	21	1992	36	2009
Mammals	Muridae	<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	EN	VU	6	2007	23	1969	1	2005
Mammals	Muridae	<i>Mesembriomys gouldii</i>	Black-footed Tree-rat	VU		1	1943	0	Unknown	0	Unknown
Mammals	Muridae	<i>Notomys aquilo</i>	Northern Hopping-mouse	VU	VU	55	2007	41	2006	3	2009
Mammals	Muridae	<i>Rattus turnneyi</i>	Pale Field-rat	VU		0	Unknown	1	1972	0	Unknown

EX = Extinct

EW = Extinct in the Wild

ER = Extinct in the NT

EN = Endangered

EN/VU = One Endangered subspecies/One Vulnerable subspecies

VU = Vulnerable

VU/- = One or more subspecies vulnerable EN/- = One or more subspecies endangered

Survey = this category refers to data collected using systematic survey methodology

Specimen = this category refers to museum or other records where a specimen has been collected and lodged

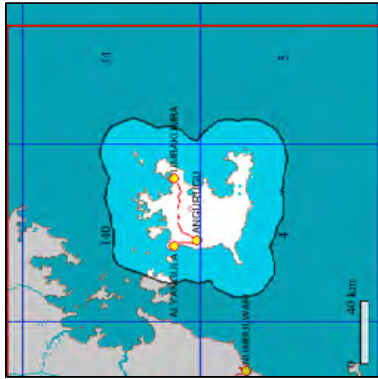
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=###](http://www.landmanager.org.au/view/index.aspx?id=###)

where ### is the ID number from the tables above for the species of interest.



Species listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



# Custom area Weeds and Potential Weeds



Introduced plants recorded in the grid cell(s) in which Custom area occurs and that have been identified as problem weeds in one or more locations in northern Australia. Occurrence based on Northern Territory Government databases.

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Asparagaceae	<i>Agave sisalana</i>	Century Plant			G&M	0	Unknown
Apocynaceae	<i>Alliandra cathartica</i>	Yellow Allamanda			C&E	0	Unknown
Amaranthaceae	<i>Alternanthera pungens</i>	Khaki Weed	B C		DEU NSW SA	0	Unknown
Anacardiaceae	<i>Anacardium occidentale</i>	Cashew Nut			C&E	0	Unknown
Polygonaceae	<i>Antigonon leptopus</i>	Coral Vine			C&E	0	Unknown
Acanthaceae	<i>Asystasia gangetica</i> subsp. <i>Gangetica</i>	Chinese Violet		ALERT	NAQS Gr	0	Unknown
Meliaceae	<i>Azadirachta indica</i>	Neem			WeedsAus MP K1 C&E G&M CYP WeedsAus	0	Unknown
Poaceae	<i>Bothriochloa pertusa</i>	Indian Bluegrass			DEU	0	Unknown
Arecaceae	<i>Caryota mitis</i>	Clustering Fishtail Palm			C&E WeedsAus	0	Unknown
Apocynaceae	<i>Cascabela thevetia</i>	Yellow Oleander			Q3 C&E G&M CYP	0	Unknown
Fabaceae	<i>Cassia fistula</i>	Golden Shower			WeedsAus	0	Unknown
Apocynaceae	<i>Catharanthus roseus</i>	Pink Periwinkle			C&E	0	Unknown
Poaceae	<i>Cenchrus browii</i>	Fine-bristled Burr Grass			NSW	0	Unknown
Poaceae	<i>Cenchrus echinatus</i>	Mossman River Grass	B C		NSW	0	Unknown
Poaceae	<i>Cenchrus pedicellatus</i>	Mission Grass (annual)			WeedsAus	0	Unknown
Poaceae	<i>Cenchrus polystachios</i>	Mission Grass (perennial)	B C		MP K2 C&E G&M	0	Unknown
Fabaceae	<i>Centrosema molle</i>	Centro			MP	0	Unknown
Poaceae	<i>Chloris barbata</i>	Purpletop Chloris			DEU	0	Unknown
Cyperaceae	<i>Cyperus rotundus</i>	Nutgrass			DEU SA	0	Unknown
Fabaceae	<i>Delonix regia</i>	Poinciana			C&E	0	Unknown
Poaceae	<i>Echinochloa colona</i>	Awnless Barnyard Grass			DEU	0	Unknown
Amaranthaceae	<i>Gomphrena celosoides</i>	Gomphrena Weed			DEU	0	Unknown
Lamiaceae	<i>Hyptis suaveolens</i>	Hyptis	B C		G&M	3	1995
Convolvulaceae	<i>Ipomoea quamoclit</i>	Cupid's Flower			C&E	0	Unknown
Euphorbiaceae	<i>Jatropha gossypifolia</i>	Bellyache Bush	B C		K2 WA1 WA4 Q2 C&E G&M CYP	0	Unknown
Meliaceae	<i>Khaya senegalensis</i>	African Mahogany			DEU	0	Unknown
Fabaceae	<i>Leucaena leucocephala</i>	Coffee Bush			C&E	0	Unknown
Fabaceae	<i>Leucaena leucocephala</i> subsp. <i>glabrata</i>	Lead Tree			MP C&E G&M CYP MP	0	Unknown
Fabaceae	<i>Macroptilium atropurpureum</i>	Siratro			C&E	0	Unknown
Poaceae	<i>Megathyrsus maximus</i>	Guinea Grass			MP DEU	2	1995
Poaceae	<i>Melinis repens</i>	Red Natal Grass			DEU	4	1995
Fabaceae	<i>Mucuna pruriens</i> var. <i>utilis</i>	Cow Itch			NAQS C&E	0	Unknown
Verbenaceae	<i>Phylla nodiflora</i> var. <i>nodiflora</i>	Lippia		ALERT	G&M NSW	0	Unknown

Family Name	Scientific Name	Common Name	NT Status	National Status	Other Status	#Surveys	Latest Record
Combrataceae	<i>Quisqualis indica</i>	Rangoon Creeper			C&E	0	Unknown
Acanthaceae	<i>Ruellia tuberosa</i>	Spearpod			C&E	0	Unknown
Asparagaceae	<i>Sansevieria trifasciata</i>	Mother-in-Law's Tongue			C&E CYP	0	Unknown
Plantaginaceae	<i>Scoparia dulcis</i>	Bitter Broom			DEU	0	Unknown
Fabaceae	<i>Senna alata</i>	Candle Bush	B C		WA1 WA2	0	Unknown
Fabaceae	<i>Senna occidentalis</i>	Coffee Senna	B C		G&M DEU	0	Unknown
Malvaceae	<i>Sida acuta</i>	Spiny-head Sida	B C		WA1 G&M	0	Unknown
Malvaceae	<i>Sida cordifolia</i>	Flannel Weed	B C		WA1 G&M DEU	0	Unknown
Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	B C		MP G&M DEU	1	1995
Poaceae	<i>Sorghum alatum</i>	Columbus Grass			NSW	0	Unknown
Bignoniaceae	<i>Spathodea campanulata</i> <i>subsp. campanulata</i>	African Tulip Tree			Q3 WeedsAus	0	Unknown
Asteraceae	<i>Sphagnetocola trilobata</i>	Singapore Daisy			Q3 C&E CYP	0	Unknown
Verbenaceae	<i>Stachytarpheta cayennensis</i>	Cayenne Snakeweed	B C		NSW	0	Unknown
Verbenaceae	<i>Stachytarpheta jamaicensis</i>	Jamaican Snakeweed	B C			0	Unknown
Verbenaceae	<i>Stachytarpheta mutabilis</i>	Pink Snakeweed	B C			0	Unknown
Fabaceae	<i>Stylosanthes hamata</i>	Caribbean Stylo			DEU	2	1995
Fabaceae	<i>Stylosanthes humilis</i>	Townsville Lucerne			DEU	0	Unknown
Fabaceae	<i>Stylosanthes scabra</i>	Shrubby Stylo			G&M DEU	0	Unknown
Asteraceae	<i>Synedrella nodiflora</i>	Cinderella Weed			C&E	0	Unknown
Zygophyllaceae	<i>Tribulus cistoides</i>	Beach Caltrop	B C			4	2006
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	B C		CYP SA	0	Unknown
Poaceae	<i>Urochloa mosambicensis</i>	Sabi Grass			DEU	0	Unknown
Poaceae	<i>Urochloa mutica</i>	Para Grass			MP G&M	0	Unknown

Status Codes:  
1. NATIONAL STATUS CODES  
Alert, Alert List for Environmental Weeds (Please call Exotic Plant Pest Hotline 1800 084 881 if you think you have seen this weed)  
Sleeper, National Sleeper Weed  
Target, Targeted for eradication. ([www.landmanager.com.au/view/index.aspx?id=449837](http://www.landmanager.com.au/view/index.aspx?id=449837))  
WONS, Weeds of National Significance

2. NT STATUS CODES  
A, NT Class A Weed (to be eradicated)  
B, NT Class B Weed (growth & spread to be controlled)  
C, NT Class C Weed (not to be introduced) ([www.landmanager.com.au/view/index.aspx?id=449869](http://www.landmanager.com.au/view/index.aspx?id=449869))

3. OTHER STATUS CODES  
C&E, Csurhes, S. & Edwards, R. (1998) Potential Environmental Weeds in Australia. Candidate Species for Preventative Control. Environment Australia, Canberra ([www.landmanager.com.au/view/index.aspx?id=394504](http://www.landmanager.com.au/view/index.aspx?id=394504))  
CYP, Dratt Cape York Peninsula Pest Management Plan 2006-2011 ([www.landmanager.com.au/view/index.aspx?id=371200](http://www.landmanager.com.au/view/index.aspx?id=371200))  
DEU, Plants listed as environmental weeds by the Desert Uplands Strategic Land Resource Assessment ([www.landmanager.com.au/view/index.aspx?id=332123](http://www.landmanager.com.au/view/index.aspx?id=332123))  
G&M, Grice AC, Martin TG. 2005. The Management of Weeds and Their Impact on Biodiversity in the Rangelands. Cooperative Research Centre (CRC) for Australian Weed Management and CSIRO Sustainable Ecosystems. Commonwealth Australia ([www.landmanager.com.au/view/index.aspx?id=163572](http://www.landmanager.com.au/view/index.aspx?id=163572))  
Gr, Groves et al. 2003. Weed categories for natural and agricultural ecosystem management. Bureau of Rural Sciences ([www.landmanager.com.au/view/index.aspx?id=388018](http://www.landmanager.com.au/view/index.aspx?id=388018))  
K0, High Priority Weeds not yet established in the Katherine region  
K1, High Priority Weeds posing environmental threats in the Katherine region  
K2, High Priority Weeds posing existing threats in the Katherine region, as described in the Katherine Regional Weed Management Strategy 2005-2010 ([www.landmanager.com.au/view/index.aspx?id=144141](http://www.landmanager.com.au/view/index.aspx?id=144141))  
MP, Northern Territory Parks & Conservation Masterplan ([www.landmanager.com.au/view/index.aspx?id=449416](http://www.landmanager.com.au/view/index.aspx?id=449416))  
NAQS, North Australian Quarantine Strategy Target List ([www.landmanager.com.au/view/index.aspx?id=449983](http://www.landmanager.com.au/view/index.aspx?id=449983))  
NSW, Declared Noxious Weed in NSW ([www.landmanager.com.au/view/index.aspx?id=449983](http://www.landmanager.com.au/view/index.aspx?id=449983))  
Q1, QLD Class 1 Weed (not to be introduced, kept or supplied)  
Q2, Class 2 Weed (eradicate where possible, not to be introduced, kept or supplied)  
Q3, Old Class 3 Weed (to be controlled near environmentally sensitive areas - not to be supplied/sold without a permit) ([www.landmanager.com.au/view/index.aspx?id=190714](http://www.landmanager.com.au/view/index.aspx?id=190714))  
SA, Declared Plant in South Australia ([www.landmanager.com.au/view/index.aspx?id=449996](http://www.landmanager.com.au/view/index.aspx?id=449996))

WeedsAus, Listed as a significant weed by Weeds Australia ([www.landmanager.com.au/view/index.aspx?id=14576](http://www.landmanager.com.au/view/index.aspx?id=14576))  
WA1. WA Weed Class P1 (movement prohibited)  
WA2. WA Weed Class P2 (aim to eradicate)  
WA3. WA Weed Class P3 (control infestations)  
WA4. WA Weed Class P4 (prevent spread)  
WA5. WA Weed Class P3 (control infestations on public land) ([www.landmanager.com.au/view/index.aspx?id=449884](http://www.landmanager.com.au/view/index.aspx?id=449884)).

Survey = this category refers to data collected using systematic survey methodology  
Specimen = this category refers to museum or other records where a specimen has been collected and lodged  
Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=###](http://www.landmanager.org.au/view/index.aspx?id=###)  
where ### is the ID number from the tables above for the species of interest.

Plants listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



## Custom area Pest and Potential Pest Animals



Animals with pest potential recorded in the grid cell(s) in which Custom area occurs. Occurrence based on Northern Territory Government databases.

Common Name	Scientific Name	NT Status	National Status	ID	#Observations (Latest)	#Specimens (Latest)	#Surveys (Latest)
Cane Toad	<i>Rhinella marina</i>	P	.	183252	0 (Unknown)	1 (1983)	4 (2010)
Asian House Gecko	<i>Hemidactylus frenatus</i>	P	.	188964	1 (2006)	3 (2010)	1 (2006)
Red-tailed Black-cockatoo	<i>Calyptorhynchus banksii</i>	N	.	223765	17 (2006)	3 (1922)	0 (Unknown)
	<i>macrorhynchus</i>						
Sulphur-Crested Cockatoo	<i>Cacatua galerita</i>	N	.	223772	33 (2009)	2 (1921)	6 (2010)
Eurasian Tree Sparrow	<i>Passer montanus</i>	P	.	450580	3 (2001)	2 (2001)	0 (Unknown)
Agile Wallaby	<i>Macropus agilis</i>	N	.	223786	11 (2008)	20 (1942)	16 (2009)
House Mouse	<i>Mus musculus</i>	P	.	187720	0 (Unknown)	3 (1989)	0 (Unknown)
Black Rat	<i>Rattus rattus</i>	P	.	183236	0 (Unknown)	4 (Unknown)	0 (Unknown)
Dingo / Wild dog	<i>Canis lupus</i>	N	.	183280	17 (2010)	0 (Unknown)	3 (2009)
Cat	<i>Felis catus</i>	P	.	183259	2 (2005)	0 (Unknown)	0 (Unknown)
Pig	<i>Sus scrofa</i>	P	.	183329	7 (1998)	0 (Unknown)	0 (Unknown)
Swamp Buffalo	<i>Bubalus bubalis</i>	P	.	183245	3 (1998)	0 (Unknown)	0 (Unknown)
Cattle	<i>Bos taurus</i>	P	.	183266	4 (1996)	0 (Unknown)	0 (Unknown)
Goat	<i>Capra hircus</i>	P	.	183301	1 (1979)	0 (Unknown)	0 (Unknown)
Rusa Deer	<i>Cervus timorensis</i>	P	.	223793	2 (2006)	0 (Unknown)	6 (2006)

### NT STATUS CODES:

Int. Introduced species (all non-prohibited vertebrates, and all other exotic species ([www.landmanager.com.au/view/index.aspx?id=280771](http://www.landmanager.com.au/view/index.aspx?id=280771)))

N. Native species with pest potential.

P. Prohibited species (all exotic vertebrates except those listed as non-prohibited ([www.landmanager.com.au/view/index.aspx?id=450509](http://www.landmanager.com.au/view/index.aspx?id=450509)))

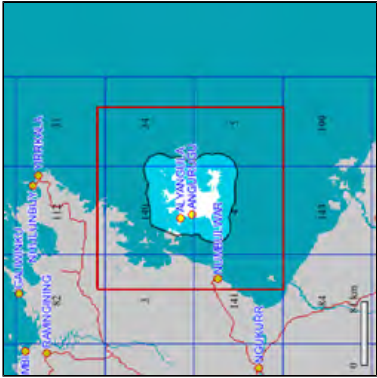
Survey = this category refers to data collected using systematic survey methodology

Specimen = this category refers to museum or other records where a specimen has been collected and lodged

Observation = this category refers to all other incidental recordings where systematic methodology may not have been used consistently.

More species info: Go to [www.landmanager.org.au/view/index.aspx?id=###](http://www.landmanager.org.au/view/index.aspx?id=###) where ### is the ID number from the tables above for the species of interest.

Potential pest animals listed in the table above were recorded from all the grid cells shown below (red/blue line) that overlap Custom area



Generated from NT Infonet (<http://www.infonet.org.au>) Fri Oct 17 09:49:41 CST 2014

Soils and vegetation graphs and tables refer to area of soils and vegetation only. Fire graphs and tables refer to entire selected area including sea if present. Calculations are derived from map images or vector data, and should be taken as a guide only. Accuracy cannot be guaranteed. For small areas, figures should be rounded to the nearest whole number.



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*Appendix F*

# Likelihood of Occurrence Assessment

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Table F.1 Likelihood of Occurrence Assessment

Common Name	Scientific Name	Conservation Status <sup>1</sup>			Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet				
<b>PLANTS</b>									
Lantern Tree	<i>Hemandia nymphaeifolia</i>		V		X		<p><b>General habitat requirements/preferences:</b> The Lantern Tree occurs exclusively in coastal areas within the littoral zone at an altitudinal range of only a few metres above sea level. It has been reported to occur along the sea-shore in littoral rainforest and in coastal swamps (Kerrigan and Cowie, 2006; Hyland <i>et al.</i>, 2010).</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. The project site is not located in a coastal area, and no suitable habitat for this species occurs in the project site.</p>	
<b>BIRDS</b>									
Red Knot	<i>Calidris canutus</i>		V		X		<p><b>General habitat requirements/preferences:</b> The Red Knot is found on intertidal mudflats, sand flats and sandy beaches in estuaries and harbours. They have also been recorded on terrestrial saline wetlands near the coast (DotE, 2013d).</p> <p><b>Foraging requirements/preferences:</b> The species is known to forage near the edge of water on intertidal mudflats and sand flats, as well as sewage ponds, and nearby lakes (DotE, 2013d).</p> <p><b>Roosting requirements/preferences:</b> The species prefers to roost near foraging grounds, but in open areas away from cover for predators. Habitat preferences include sandy beaches, spits, islets,</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. No suitable habitat for this species occurs in the project site, which is located outside of coastal areas.</p> <p>The NRM InfoNet database identifies occurrences of the species on Grootte Eylandt, but not within the project site.</p> <p>The species has not been recorded in previous surveys performed by URS</p>	

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Curlw Sandpiper	<i>Calidris ferruginea</i>		V		X		<p>mudflats, and shallow saline ponds of salt works (DotE, 2013d).</p> <p><b>Breeding requirements/preferences:</b> The Red Knot lays its eggs in June. Its nests are usually on open vegetated stone ridges or tundra, near a clump of vegetation (DotE, 2013d).</p> <p><b>General habitat requirements/preferences:</b> The Curlw Sandpiper is found in coastal areas with intertidal mudflats, including estuaries, inlets and lagoons, and ponds in salt works. The species has also occasionally been recorded inland around lakes, dams and waterholes with mud or sand present (DotE, 2013e).</p> <p><b>Foraging requirements/preferences:</b> Main requirements for feeding habitats are the presence of mudflats or shallow water up to 60mm. The Curlw Sandpiper may also forage in salt marsh environments and flooded paddocks (DotE, 2013e).</p> <p><b>Roosting requirements/preferences:</b> Roosting usually occurs on bare dry shingle, shell or sand beaches, sandspits and islets around coastal lagoons and other wetlands (DotE, 2013e).</p> <p><b>Breeding requirements/preferences:</b> The species does not breed in Australia (DotE, 2013e).</p>	<p>(2012) and Webb (1992).</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p> <p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. No suitable habitat for this species occurs in the project site, which is located outside of coastal areas. Although this species has occasionally been recorded inland around waterbodies, there are no open areas for foraging around the waterholes within the project site.</p> <p>The NRM InfoNet database identifies occurrences of the species on Groote Eylandt, but not within the project site.</p> <p>The species has been recorded previously on the island by Webb (1992), however the exact location is</p>



Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Great Knot	<i>Calidris tenuirostris</i>		V		X		<p>unknown.</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p> <p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. No suitable habitat for this species occurs in the project site, which is located outside of coastal areas.</p> <p>The NRM InfoNet identifies occurrences of the species on Grootte Eylandt, but not within the project site.</p> <p>The species has not been recorded in previous surveys performed by URS (2012) and Webb (1992). Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>	

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Greater Sand Plover	<i>Charadrius leschenaultii</i>		V		X		<p><b>General habitat requirements/preferences:</b> The Greater Sand Plover inhabits coastal littoral and estuarine environments, and is mainly found on sandy or muddy beaches with intertidal mudflats or sandbanks, rock platforms, inshore reefs or sand cays on coral reefs (DotE, 2013g).</p> <p><b>Foraging requirements/preferences:</b> The species forages visually over the surface of the substrate or just below the surface. It prefers to forage in areas that have low densities of other foraging shorebirds (DotE, 2013g).</p> <p><b>Roosting requirements/preferences:</b> The Greater Sand Plover usually roosts on banks, sand-spits, beaches, or in tidal lagoons. They are also known to roost on rocky points and in salt marshes (DotE, 2013g).</p> <p><b>Breeding requirements/preferences:</b> This species does not breed in Australia (DotE, 2013g).</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. Its preferred foraging habitat of coastal or estuarine areas does not occur within the project site.</p> <p>The NRM InfoNet database identifies occurrences of the species on Groote Eylandt, but not within the project site. The species has been recorded previously on the island by URS (2012), however the exact location is unknown.</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>
Lesser Sand Plover	<i>Charadrius mongulus</i>		V		X		<p><b>General habitat requirements/preferences:</b> The Lesser Sand Plover is found in coastal littoral and estuarine environment, with preferred habitats including large intertidal sand flats or mudflats in sheltered bays, harbours and estuaries, and sometimes also sandy</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. Its preferred foraging habitat of coastal or estuarine areas does not occur within the project</p>



Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
							<p>ocean beaches, coral reefs, and rock platforms (DotE, 2013h).</p> <p><b>Foraging requirements/preferences:</b> Preferred foraging habitat consists of vast, freshly-exposed intertidal sand flats and mudflats in beaches, estuaries and ponds in salt works. They are also known to feed on coral reef, river margins, and muddy areas around lakes (DotE, 2013h).</p> <p><b>Roosting requirements/preferences:</b> Roosting habitat is usually near foraging areas, but it is known to roost inland on sandbanks in swamp, grassy margins of ephemeral pools, and inland claypan (DotE, 2013h).</p> <p><b>Breeding requirements/preferences:</b> The Lesser Sand Plover is a migratory bird which breeds in Mongolia and Siberia, and typically overwinters in Australia. It is not known to breed in Australia (DotE, 2013h).</p>	<p>site.</p> <p>The NRM InfoNet database identifies occurrences of the species on Groote Eylandt, but not within the project site.</p> <p>Although the Lesser Sand Plover has previously been recorded on Groote Eylandt, records are from coastal and estuarine areas (URS Australia Pty Ltd, 2012).</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>
Red Goshawk	<i>Erythrotriorchis radiatus</i>	V		X		X	<p><b>General habitat requirements/preferences:</b> The Red Goshawk prefers woodlands and forests with a mosaic of vegetation types that are open enough for fast manoeuvring flight. These favoured areas contain permanent water and have large populations of birds of other species (DotE, 2013m).</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. There are no records of this raptor on Groote Eylandt within the NRM InfoNet database and it has not been recorded</p>

Common Name	Scientific Name	Conservation Status <sup>1</sup>			Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet				
							Foraging requirements/preferences: The Red Goshawk generally avoids very dense or very open habitats, preferring to hunt along their ecotones (DotE, 2013m). <b>Roosting requirements/preferences:</b> The species nests in tall trees in open forest and woodland near permanent water bodies. Their nest is usually placed on a horizontal branch against a vertical branch (DotE, 2013m). <b>Breeding requirements/preferences:</b> Breeding generally occurs from August to November and nesting territories are reused by breeding pairs year after year (DotE, 2013m).	during previous surveys by URS (2012) and Webb (1992).  The EPBC PMST identifies that the species or species habitat is likely to occur within the 20 km search radius. It should be noted that the PMST results are based on broad scale habitat modelling, rather than actual records of the species.  The vegetation on the project site could provide suitable habitat for the Red Goshawk. However, the species has a low potential to occur on the project site, given that it has never been recorded on Grootte Eylandt, despite numerous fauna surveys.	
Gouldian Finch	<i>Erythrura gouldiae</i>	E	V		X		<b>General habitat requirements/preferences:</b> The main habitat requirements for the Gouldian Finch are the presence of grasses (especially Sorghum), close proximity to permanent water, and open woodlands dominated by Eucalypts (DotE, 2014c). <b>Foraging requirements/preferences:</b>	<b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys.  The NRM InfoNet database contains a single record of occurrence of this	



Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
							<p>The species feeds almost exclusively on seeds taken from grasses such as Sorghum, although they also take seeds from grasses in other genera including <i>Alloteropsis</i>, <i>Aristida</i>, <i>Chrysopogon</i>, <i>Digitaria</i>, <i>Echinochloa</i>, <i>Eriachne</i>, <i>Heteropogon</i>, <i>Panicum</i>, <i>Schizachyrium</i>, <i>Sehima</i>, <i>Themeda</i>, <i>Triodia</i> and <i>Xerochloa</i>. The species has also been recorded foraging in areas burnt by fire. (DotE, 2014c).</p> <p><b>Roosting requirements/preferences:</b> The Gouldian Finch usually nests in Eucalyptus tree hollows, but is also known to nest in shrubs among grass and in termite mound hollows (DotE, 2014c).</p> <p><b>Breeding requirements/preferences:</b> Breeding habitat usually occurs on ridges and rocky foothills. A critical habitat requirement for breeding is the presence of unburnt hollow-bearing Eucalyptus trees (DotE, 2014c).</p>	<p>species on Grootte Eylandt (although the record is not from within the project site). The record is from the year 1925, and there have been no further records of this species since then, despite numerous fauna surveys on the island. In particular, the Gouldian Finch was not recorded during surveys by URS (2012) and Webb (1992).</p> <p>The vegetation on the project site could provide suitable habitat for the Gouldian Finch. However, the species is not predicted to occur on the project site, given a lack of records on Grootte Eylandt.</p>
Partridge Pigeon	<i>Geophaps smithii</i>	V	V		X		<p><b>General habitat requirements/preferences:</b> The Partridge Pigeon inhabits Eucalyptus tetrodonta and E. miniata dominated open forest and woodland (DotE, 2013n).</p> <p><b>Foraging requirements/preferences:</b> Main foraging habitat requirements include areas with an open ground layer, or locations which have recently</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. Three records of this species on Grootte Eylandt are held within the NRM InfoNet database, however no date for these records is provided. This</p>

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Bar-tailed Godwit	<i>Limosa lapponica</i>		V		X		<p>been burnt. It relies on perennial grass species which set seed relatively early (e.g. <i>Chrysopogon fallax</i> and <i>Alloteropsis semialata</i>) (DoIE, 2013n).</p> <p><b>Roosting requirements/preferences:</b> The species roosts and nests on the ground, in areas with dense vegetation cover (DoIE, 2013n).</p> <p><b>Breeding requirements/preferences:</b> Little is known about the breeding of the species, but it is known to lay eggs throughout the year. Nests are usually constructed in a shallow depression and lined with leaves or grass (DoIE, 2013n).</p>	<p>species has not been recorded during previous surveys by URS (2012) and Webb(1992).</p> <p>It is a relatively conspicuous species and has not been found in any previous surveys of the existing GEMCO mine or the project site, despite surveys having been undertaken on the existing GEMCO mine and/or the project site within the past 25 years.</p> <p>Suitable habitat for this species is present in the project site in the form of <i>E. tetradonta</i> and <i>E. miniata</i> dominated open forest and woodland.</p> <p>Nevertheless, the species is assessed as having a low likelihood of occurrence, given the lack of records in recent years.</p>
							<p><b>General habitat requirements/preferences:</b> The Bar-tailed Godwit is mainly a coastal species, and inhabits intertidal sand flats, mudflats, estuaries,</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. No suitable habitat</p>





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		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
							<p>harbours and coastal lagoons. The species have been recorded in coastal sewage farms and salt lakes and brackish wetlands, sandy ocean beaches, rock platforms, and around beds of seagrass (DotE, 2013q).</p> <p><b>Foraging requirements/preferences:</b> Preferred feeding habitats include shallow water or the edge of water in tidal estuaries, harbours, or soft mud with seagrass beds.</p> <p><b>Roosting requirements/preferences:</b> Main habitat requirements for roosting include sandy beaches and near-coastal salt marshes (DotE, 2013q).</p> <p><b>Breeding requirements/preferences:</b> The Bar-tailed Godwit does not breed in Australia (DotE, 2013q).</p>	<p>for this species occurs in the project site, which is located outside of coastal areas.</p> <p>The NRM InfoNet identifies six occurrences of the species from coastal areas of the Groote Eylandt archipelago.</p> <p>A single record of occurrence of this species was noted within the project site, however this record is from the year 1922. The location of this single record of the Bar-tailed Godwit has been also been attributed to 83 other species identified in 1921 and 1922 during an expedition to the island by Norman Tindale (Australian Government, 2014). It appears that a single, central coordinate was utilised to attribute the location of all 83 species that Tindale found during his expedition. It is therefore considered that the record of the Bar-tailed Godwit</p>

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Eastern Curlew	<i>Numenius madagascariensis</i>		V		X		<p>within the project site is likely to be erroneous, particularly given there is no suitable habitat for this species within the project site.</p> <p>There have been no further records of this species this far inland since 1922, despite numerous fauna surveys on the island. In particular, this species was not recorded during surveys by URS (2012) and Webb (1992).</p> <p>Given the lack of suitable coastal habitat, and lack of recent records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. No suitable habitat for this species occurs in the project site, which is located outside of coastal areas.</p>	
							<p><b>General habitat requirements/preferences:</b> The Eastern Curlew prefers sheltered coast environments, and occurs in estuaries, harbours, coastal lagoons, with intertidal mud or sand flats with associated seagrass beds. The species are frequent in salt marshes and on mudflats with mangroves (DotE, 2013u).</p>		



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Masked Owl (northern)	<i>Tyto novaehollandiae kimberli</i>	V	V			X	<p><b>Foraging requirements/preferences:</b> Foraging habitats include sheltered intertidal sand and mudflats, salt flats, rockpools and on ocean beaches (DotE, 2013u).</p> <p><b>Roosting requirements/preferences:</b> Main requirements for roosting are sandy spits and islets on dry beach or among coastal vegetation (DotE, 2013u).</p> <p><b>Breeding requirements/preferences:</b> The Eastern Curlew does not breed in Australia (DotE, 2013u).</p>	<p>The NRM InfoNet database identifies occurrences of the species on Groote Eylandt, but not within the project site boundary.</p> <p>The species has not been recorded in previous surveys performed by JRS (2012) and Webb (1992).</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p> <p><b>Present.</b> This species was recorded within the project site at numerous locations during the May/June 2014 EIS survey. The species was recorded within <i>Eucalyptus tetradontal/Eucalyptus miniata</i> open forest.</p> <p>The Masked Owl (northern) was previously recorded at 10 locations within the project site by EMS (2013).</p>

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Fork-tailed Swift	<i>Apus pacificus</i>	M(m)		X			<p><b>Breeding requirements/preferences:</b> Little is known about the life cycle of the species but it is believed to breed between March–October (DotE, 2013w).</p> <p>Suitable habitat is present throughout the project site as remnant vegetation exists throughout the site. There is excellent habitat connectivity in the landscape with no areas of cleared vegetation on the site. Large hollow-bearing trees are present on the project site, and have been recorded previously (EMS, 2013; EMS, 2014b).</p> <p><b>Moderate likelihood of occurrence.</b> Potential overfly habitat is present in the project site, although this species prefers foraging above dry and open habitats rather than in the predominantly wooded forests in the project site.</p> <p>The EPBC PMST identifies the species or species habitat as being likely to</p>	
							<p><b>General habitat requirements/preferences:</b> The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. The species mostly occurs over inland plains, open habitats, riparian woodland, tea-tree swamps, and occasionally above foothills or in coastal areas. They also occur over settled areas, including towns, urban areas and cities (DotE, 2013a).</p> <p><b>Foraging requirements/preferences:</b> The species forages aerially, often in updraughts, near</p>	



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Streaked Shearwater	<i>Calonectris leucomelas</i>	M(m)		X			<p>cliffs (DotE, 2013a). This species prefers foraging above dry and open habitats (DotE, 2013a).</p> <p><b>Roosting requirements/preferences:</b> The species is likely to roost aerially, but are occasionally observed to land (DotE, 2013a).</p> <p><b>Breeding requirements/preferences:</b> The Fork-tailed Swift does not breed in Australia (DotE, 2013a).</p>	<p>occur within a 20 km radius of the project site.</p> <p>The species has been recorded in previous surveys by URS (2012), however the exact location is unknown.</p> <p>Given the presence of potential suitable habitat, and recent records of this species on Grootte Eylandt, it is assessed as having a moderate likelihood of occurrence.</p>
							<p><b>General habitat requirements/preferences:</b> The species has been observed over open ocean and on islands (Takahashi <i>et al.</i>, 2008).</p> <p><b>Foraging requirements/preferences:</b> Areas near the continental shelf that have high primary productivity may be suitable foraging habitat (Takahashi <i>et al.</i>, 2008).</p> <p><b>Roosting requirements/preferences:</b> The species is known to nest in burrows (Takahashi <i>et al.</i>, 2008).</p> <p><b>Breeding requirements/preferences:</b></p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. No suitable habitat for this species occurs in the project site, which is located outside of coastal areas.</p> <p>The EPBC PMST identifies that the species or species habitat may occur within a 20 km radius of the project site. However, this result should be</p>

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
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White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	M(t)		X		X	<p>This species does not breed in Australia (Takahashi <i>et al.</i>, 2008).</p> <p>The NRM InfoNet database does not identify any records of the species within Groote Eylandt.</p> <p>The species has not been recorded in previous surveys performed by URS (2012) and Webb (1992).</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>	<p>viewed in light of the fact that the PMST radius includes coastal areas, not representative of the project site.</p> <p>The EPBC PMST identifies the species or species habitat as being known to occur within a 20 km radius of the</p>
							<p><b>General habitat requirements/preferences:</b> The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and seas). Birds have been recorded in</p>	<p><b>Moderate likelihood of occurrence.</b> Some suitable nesting habitat for this species is present within the project site.</p>



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							(or flying over) a variety of terrestrial habitats (DotE, 2014d). <b>Foraging requirements/preferences:</b> The species forages over open water, in-shore water and open terrestrial habitats (DotE, 2014d). <b>Roosting requirements/preferences:</b> The White-bellied Sea-Eagle roosts in large nests built in Eucalypts, bushes, mangroves, cliffs, rocky outcrops, crevices, caves, ground, and man-made structures (DotE, 2014d). <b>Breeding requirements/preferences:</b> The breeding season typically occurs from June to January. Breeding territories are located on the coast, offshore islands and inland. Locations are close to water and usually contain tall open forest or woodland (DotE, 2014d).	project site.  The species has also been recorded during previous surveys by URS (2012), however the exact location is unknown.  Given the presence of suitable nesting habitat, and recent records of this species on Groote Eylandt, it is assessed as having a moderate likelihood of occurrence.	
Barn Swallow	<i>Hirundo rustica</i>	M(t)		X			<b>General habitat requirements/preferences:</b> The Barn Swallow occurs in open areas in coastal lowlands, in close proximity to water, towns and cities, as well as around freshwater wetlands, paperbark Melaleuca woodland, and tussock grassland. It is often recorded sitting on overhead wires or bare branches (DotE, 2013p). <b>Foraging requirements/preferences:</b>	<b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. There are no records of this species from Groote Eylandt on the NRM InfoNet database.  It has not been recorded on Groote Eylandt during previous surveys by	



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							<p>The species prefers to feed on insects by aerial pursuit or by skimming plants or water surface. It is occasionally seen feeding on roads, paths and beaches (DotE, 2013p).</p> <p><b>Roosting requirements/preferences:</b></p> <p>The Barn Swallow nests on small vertical surfaces, such as window-ledges of buildings, typically, two to five metres from the ground (DotE, 2013p).</p> <p><b>Breeding requirements/preferences:</b></p> <p>The species does not breed in Australia (DotE, 2013p).</p>	<p>URS (2012) and Webb (1992).</p> <p>The EPBC PMST identifies that the species or species habitat may occur within a 20 km radius of the project site. It should be noted that the PMST results are based on broad scale habitat modelling, rather than actual records of the species.</p> <p>Some potential habitat for the Barn Swallow is present in the project site, however this species prefers more open habitats than the predominantly wooded forests found in the project site.</p> <p>Although the vegetation on the project site has some potential to provide habitat for the Barn Swallow, this species has been assessed as having a low potential to occur, given that it has never been recorded on Groote Eylandt, despite numerous fauna</p>





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Rainbow Bee-eater	<i>Merops ornatus</i>	M(t)		X		X	<p><b>General habitat requirements/preferences:</b> Open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (DotE, 2013s). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (DotE, 2013s).</p> <p><b>Foraging requirements/preferences:</b> The species usually forages aerially from open perches but is also known to forage on the ground. It is found around beehives, foraging on <i>Apis mellifera</i> (honey bees) (DotE, 2013s).</p> <p><b>Roosting requirements/preferences:</b> The species builds nests in a chamber at the end of a long tunnel in sloped ground, banks of rivers, creeks, dams or in cliff-faces (DotE, 2013s).</p> <p><b>Breeding requirements/preferences:</b> Breeding occurs from August to January in areas where individuals can excavate tunnels for their nests. Suitable breeding habitat includes, flat and sloped ground, banks of rivers creeks, dams, cliff faces, or road-side cuttings (DotE, 2013s).</p>	<p>surveys.project site.</p> <p><b>Present.</b> Recorded at numerous locations within the project site during the May/June 2014 EIS survey. This species was recorded in woodland and open forest, particularly those dominated by <i>E. tetradonta</i> and <i>E. miniata</i>.</p> <p>The EPBC PMST identifies that the species or species habitat may occur within a 20 km radius of the project site.</p> <p>This species has been recorded in previous surveys by URS (2012) and Webb (1992), however the exact location is unknown.</p>

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Rufous Fantail	<i>Rhipidura rufifrons</i>	M(t)		X			<p><b>General habitat requirements/preferences:</b> In north and north-east Australia, the species has been recorded mainly in tropical and monsoon rainforest (DotE, 2013v).</p> <p><b>Foraging requirements/preferences:</b> The species prefers to forage in the low to middle strata of forests and sometimes in the canopy or on the ground. They are known to forage in mangroves in northern Australia (DotE, 2013v).</p> <p><b>Roosting requirements/preferences:</b> Roosting occurs in nests made from grass, roots, bark, wood, moss and spider web. Nests are found in trees, shrubs, and vines, typically lower than 6 metres from the ground (DotE, 2013v).</p> <p><b>Breeding requirements/preferences:</b> Breeding occurs from September to February (DotE, 2013v).</p>	<p><b>Moderate likelihood of occurrence.</b> This species was not recorded during EIS field surveys. However, very small areas of monsoon vine forest are present in the project site that may provide some habitat for this species.  NRM InfoNet does not identify any records of the species, however it has been recorded during a previous survey by Webb (1992) in monsoon vine forest on the western side of Groote Eylandt.  The EPBC PMST identifies the species or species habitat as known to occur within a 20 km radius of the project site.  Given the presence of some suitable habitat, and recent records of this species on Groote Eylandt, it is assessed as having a moderate likelihood of occurrence.</p>



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Eastern Great Egret	<i>Ardea modesta</i>	M(w)		X			<p><b>General habitat requirements/preferences:</b> The Eastern Great Egret has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial) (DotE, 2013b). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (DotE, 2013b).</p> <p><b>Foraging requirements/preferences:</b> The species primarily forages in shallow to moderately deep water (DotE, 2013b).</p> <p><b>Roosting requirements/preferences:</b> Roosting occurs in shallow nests located in the upper strata of shrubs or trees near water (DotE, 2013b).</p> <p><b>Breeding requirements/preferences:</b> The breeding season extends from November to April, but fluctuates depending on rainfall. Breeding sites are typically located in wooded and shrubby swamps, including mangrove forests (DotE, 2013b).</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. There are no records of this species on Groote Eylandt within the NRM InfoNet database.</p> <p>This species has been recorded in previous surveys by URS (2012), however the exact location is unknown.</p> <p>The EPBC PMST identifies the species or species habitat as being known to occur within a 20 km radius of the project site.</p> <p>Some areas of the project site could provide suitable temporary habitat for the Eastern Great Egret during the wet season. However, the species has a low potential to occur on the project site, given the few records and lack of permanent wetlands, despite</p>

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Cattle Egret	<i>Ardea ibis</i>	M(w)		X			<p>numerous fauna surveys.</p> <p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys. There are no records of this species on Groote Eylandt within the NRM InfoNet database and it has not been recorded during previous surveys by URS (2012) and Webb (1992).</p> <p>The EPBC PMST identifies that the species or species habitat may occur within a 20 km radius of the project site.</p> <p>Some areas of the project site could provide suitable temporary habitat for the Cattle Egret during the wet season. However, the species has a low potential to occur on the project site, given that it has never been recorded on Groote Eylandt, despite numerous fauna surveys..</p>	



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Oriental Plover	<i>Charadrius veredus</i>	M(w)		X			<p><b>General habitat requirements/preferences:</b> The Oriental Plover is known to spend several weeks in coastal areas when first arriving in northern Australia, and then eventually moves further inland. The species prefers flat, open, grasslands with areas of bare ground or areas recently burnt, including dry paddocks or clay pans. The species has also been sighted near terrestrial wetlands and in salt marshes (DotE, 2013).</p> <p><b>Foraging requirements/preferences:</b> The species is usually found foraging in short grass or on stony bare ground. It is also known to feed on mudflats and on beaches with beach cast seaweed (DotE, 2013).</p> <p><b>Roosting requirements/preferences:</b> Oriental Plovers roost on wet mud, near the shallow water of beaches, and in salt marshes or paddocks (DotE, 2013).</p> <p><b>Breeding requirements/preferences:</b> The species does not breed in Australia (DotE, 2013).</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys.</p> <p>No suitable habitat for this species occurs in the project site, which is located outside of coastal areas and areas of flat, open grasslands and floodplains.</p> <p>The EPBC PMST identifies that the species or species habitat may occur within a 20 km radius of the project site. However, this result should be viewed in light of the fact that the PMST radius includes coastal areas, not representative of the project site.</p> <p>NRM InfoNet database does not identify occurrences of the species on Groote Eylandt.</p> <p>The species has not been recorded in previous surveys by URS (2012) and</p>

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Oriental Pratincole	<i>Glareola maldivarum</i>	M(w)		X			<p>Webb (1992).</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p> <p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys.</p> <p>No suitable habitat for this species occurs in the project site, which is located outside of coastal areas and areas of flat, open grasslands and floodplains.</p> <p>NRM InfoNet database does not identify occurrences of the species on Grootte Eylandt.</p> <p>The EPBC PMST identifies the species as having potential to occur within a 20 km radius of the project site.</p>	



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								<p>The species has not been recorded in previous surveys by URS (2012) and Webb (1992).</p> <p>Given the lack of suitable habitat, and lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>
<b>MAMMALS</b>								
Brush-tailed Rabbit-rat	<i>Conilurus penicillatus</i>	V	E	X	X	X	<p><b>General habitat requirements/preferences:</b>                      The main habitat requirements for the Brush-tailed Rabbit-rat are mixed eucalypt open forest and woodland, or dunes with Casuarina. It requires the presence of shelter, in the form of tree hollows, hollow logs and occasionally the crown of pandanus. The species appears to have a preference for areas with an understory dominated by perennial grasses, and in general areas which are not burnt annually (DotE, 2013).</p> <p><b>Foraging requirements/preferences:</b>                      The species is primarily granivorous, feeding on seed from perennial grasses. It is also known to eat leaves, plant stems, and insects (DotE, 2013).</p>	<p><b>Present.</b>                      Recorded at one location within the project site during the EIS survey.</p> <p>This species was recorded on an IR camera during the EIS survey within <i>E. tetradonta/E. miniata</i> open forest.</p> <p>The EPBC PMST identifies that the species or species habitat may occur within a 20 km radius of the project site.</p> <p>The NRM InfoNet database identified</p>

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Northern Quoll	<i>Dasyurus hallucatus</i>	E	CE	X	X	X	<p><b>Requirements/preferences for shelter sites:</b> Known denning habitat for the species is hollow logs (DotE, 2013).</p> <p><b>Breeding requirements/preferences:</b> Breeding season occurs from March to October with a litter size tending to be two (DotE, 2013j).</p> <p><b>General habitat requirements/preferences:</b> The broadly described habitats of the Northern Quoll include rocky areas, Eucalypt forests and woodlands, sandy lowlands, grasslands, shrublands, and deserts (DotE, 2013l).</p> <p><b>Foraging requirements/preferences:</b> The species is known to feed on a wide range of prey including mammals, insects, fruit and human refuse (DotE, 2013l).</p> <p><b>Requirements/preferences for shelter sites:</b> Main habitat requirements for denning include rock crevices, hollow logs and termite mounds (DotE, 2013).</p> <p><b>Breeding requirements/preferences:</b> Breeding habitat for the Northern Quoll occurs within den sites. Breeding occurs in mid-dry season and breeding territory is likely inherited by female offspring (DotE, 2013l).</p>	<p>this species as occurring on Groote Eylandt.</p> <p>The Brush-tailed Rabbit-rat has been recorded previously within the project site by Ward (2007a) and EMS (2013).</p> <p><b>Present.</b> Recorded at numerous locations within the project site during the May/June and October 2014 EIS surveys, and within areas of mine rehabilitation in the existing GEMCO mine.</p> <p>Recorded within all forest and woodland habitats in the project site. Thirty-two records of this species are held within the NRM InfoNet database and it has been recorded during previous surveys by URS (2012) and Webb (1992), however the exact location is unknown.</p> <p>The EPBC PMST identifies the species or species habitat as being known to</p>





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Northern Hopping-mouse	<i>Notomys aquilo</i>	V	V	X	X	X	<p>occur within a 20 km radius of the project site.</p> <p><b>Present.</b> Recorded at one location adjacent to the proposed haul road during the current survey, with one animal caught by hand. Recorded within E. tetradonta/E. miniata open forest.</p> <p>The EPBC PMST identifies the species or species habitat may occur within a 20 km radius of the project site.</p> <p>The species is identified as occurring by the NRM InfoNet database.</p> <p>This species was not recorded during surveys by URS (2012) and Webb (1992).</p> <p>Habitat throughout the project site is optimum for the species. The Northern Hopping-mouse prefers sandy soils with a cover of tussock or heath. The</p>	<p><b>General habitat requirements/preferences:</b> The Northern Hopping-mouse inhabits coastal dune systems, shrubland, eucalypt woodland, and the margins of coastal rainforest areas. Main habitat requirements are areas with sandy substrates and relatively high rainfall (about 1000-1400 mm per year), preferring areas in close proximity to rocky areas (DotE, 2013t).</p> <p><b>Foraging requirements/preferences:</b> The species feeds mainly on a seeds from grasses, herbs and shrubs. It is also known to eat insects (DotE, 2013t).</p> <p><b>Requirements/preferences for shelter sites:</b> The Northern Hopping-mouse constructs complex burrows that can be used for sheltering which consist of a spoil mound located 2 m from the burrow entrance. The entrance is a vertical shaft that is dug from below (DotE, 2013t).</p> <p><b>Breeding requirements/preferences:</b> All breeding information is based on observations made in captivity. The young are born hairless with one to five young being reared at a time (DotE, 2013t).</p>

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Pale Field Rat	<i>Rattus tunneyi</i>		V		X	X	<p>grassy understorey of woodlands and open forests within the project site would provide a range of foraging opportunities for this species and provide suitable breeding habitat throughout the site.</p> <p><b>Low likelihood of occurrence.</b> Limited potential habitat occurs within the project site, with no mapped areas of tall grassland occurring.</p> <p>One record of this species on Groote Eylandt is held within the NRM InfoNet database from 1972 and it is unclear if this species still occurs on the island.</p> <p>It has not been recorded during previous surveys of the project site, or from other surveys on the island by URS (2012) and Webb (1992). Given the lack of records of this species within the project site, it is assessed as having a low likelihood of occurrence.</p>	
							<p><b>General habitat requirements/preferences:</b> The Pale Field Rat occurs in higher rainfall areas of northern Australia, and inhabits tall grassland, cane fields and other modified habitats supporting its feeding preferences consisting of roots, grass, stems and seeds (Morris <i>et al.</i>, 2008).</p> <p><b>Foraging requirements/preferences:</b> This species feeds on roots, grasses, stems and seeds (Northern Territory Government, 2012a). Requirements/preferences for shelter sites: This nocturnal species uses shallow burrows in loose sandy soil, as shelter during the day (Morris <i>et al.</i>, 2008).</p> <p><b>Breeding requirements/preferences:</b> Burrows are utilised for breeding which takes place during the dry season (Northern Territory Government, 2012a).</p>	



Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Water Mouse	<i>Xeromys myoides</i>	V		X		X	<p><b>General habitat requirements/preferences:</b> The broadly described habitats of the Water Mouse include sedgelands, heathlands, clay pans, mangroves and the associated salt marsh, and freshwater wetlands (DotE, 2013x). In the Northern Territory, the Water Mouse has been known to use both intertidal and freshwater habitats, including mangroves, sedgelands, clay pans, and freshwater melaleuca wetlands (DotE, 2013x).</p> <p><b>Foraging requirements/preferences:</b> In the Northern Territory, the species is known to feed on graspid crabs (i.e. shore crabs), and plant foods are believed to comprise some of its diet (DotE, 2013x).</p> <p><b>Requirements/preferences for shelter sites:</b> The species is known to make five types of nests which provide refuge from predators at high tide. These are: free-standing, nests or mounds at the base of mangrove trees, mound nests on small elevated 'islands' within the tidal zone, mound nests or holes in supralittoral banks; nests inside hollow tree trunks, and nests in spoil heaps created as a result of human activity (DotE, 2013x).</p> <p><b>Breeding requirements/preferences:</b> Nests created by the species are important for breeding and it is capable of breeding year-round (DotE, 2013x).</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys.</p> <p>None of the broad habitats required by this species are present within the project site. Some areas with melaleucas form temporary "wetlands" following the wet season, but these rapidly dry out in the dry season.</p> <p>No records of this species on Groote Eylandt are held within the NRM InfoNet database and it has not been recorded during previous surveys by URS (2012) and Webb (1992).</p> <p>The EPBC PMST identifies the species or species habitat may occur within a 20 km radius of the project site. However, this result should be viewed in light of the fact that the PMST radius includes coastal mangrove areas, which is not representative of the</p>

Common Name	Scientific Name	Conservation Status <sup>1</sup>			Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet				
								project site.  Given the lack of permanent wetland habitat and lack of records of this species on the island, it is assessed as having a low likelihood of occurrence.	
<b>REPTILES</b>									
Plains Death Adder	<i>Acanthopis hawkei</i>	V		X		X	<p><b>General habitat requirements/preferences:</b> The Plains Death Adder inhabits flat treeless habitats on the cracking soils of riverine floodplains (Northern Territory Government, 2012b).</p> <p><b>Foraging requirements/preferences:</b> When young, the species feeds on frogs and lizards, and when they reach larger sizes the species feeds on mammals (Northern Territory Government, 2012b).</p> <p><b>Requirements/preferences for shelter sites:</b> During floods, the species floats on debris or emergent vegetation. During the Dry season, it often rests in deep cracks in the soil (Northern Territory Government, 2012b).</p> <p><b>Breeding requirements/preferences:</b> The species breeds from October to November and live young are produced between February and March</p>	<p><b>Low likelihood of occurrence.</b> This species was not recorded during EIS field surveys.</p> <p>No suitable habitat for this species occurs in the project site.</p> <p>The EPBC PMST identifies the species or species habitat may occur within a 20 km radius of the project site. It should be noted that the PMST results are based on broad scale habitat modelling, rather than actual records of the species.</p> <p>The NRM InfoNet results do not</p>	



Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Yellow-spotted Monitor	<i>Varanus panoptes</i>		V		X	X	(Threatened Species Scientific Committee, 2011).	<p>identify occurrences of the species on Groote Eylandt.</p> <p>The species was not recorded during previous surveys by URS (2012) and Webb (1992). Given the lack of records of this species on Groote Eylandt, it is assessed as having a low likelihood of occurrence.</p>
							<p><b>General habitat requirements/preferences:</b> The Yellow-spotted Monitor occurs in a variety of habitats including grasslands, woodlands, floodplains, and coastal beaches. Its distribution has been recorded across most of the Top End of the Northern Territory (Northern Territory Government, 2012c).</p> <p><b>Foraging requirements/preferences:</b> The species forages on primarily small terrestrial insects and vertebrates, including marine and freshwater turtle eggs (Northern Territory Government, 2012c).</p> <p><b>Requirements/preferences for shelter sites:</b> The species is known to dig large burrows and take over existing burrows (Atlas of Living Australia, 2014). Recent research has indicated that these species make</p>	<p><b>Present.</b> Recorded at four locations within the project site during the EIS field surveys. This species was recorded in E. tetradonta/E. miniata open forest and Melaleuca woodland. It has been recorded during surveys by URS (2012) in Melaleuca/riparian habitat, Eucalypt forest habitat and within areas of mine rehabilitation in the existing GEMCO mine.</p> <p>The NRM InfoNet database results identify occurrences of the species on</p>

Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Mertens' Water Monitor	<i>Varanus mertensi</i>		V		X	X	<p>use of large communal burrows / warrens (Doody, <i>et al.</i>, 2014).</p> <p><b>Breeding requirements/preferences:</b> The Yellow-spotted Monitor lays its eggs in burrows in the ground, usually during the wet season (Northern Territory Government, 2012c).</p> <p><b>General habitat requirements/preferences:</b> The semi-aquatic Mertens' Water Monitor is found in the proximity of water sources, inhabiting both coastal and inland waters and riparian areas (Northern Territory Government, 2006).</p> <p><b>Foraging requirements/preferences:</b> The species feeds primarily on fish, frogs and carrion, but it will also forage for insects and small terrestrial invertebrates (Northern Territory Government, 2006).</p> <p><b>Requirements/preferences for shelter sites:</b> The Mertens' Water Monitor is terrestrial and also has the ability to climb trees (Northern Territory Government, 2006).</p> <p><b>Breeding requirements/preferences:</b> The species digs burrows in the ground where it lays its eggs, usually during the early dry season (Northern Territory Government, 2006).</p>	<p>Groote Eylandt.</p> <p><b>Present.</b> Recorded along most streams within the project site during the EIS field surveys. Recorded within freshwater streams and in Melaleuca dominated communities.</p> <p>This species has also been recorded during previous surveys by URS (2012) and Webb (1992).</p> <p>The NRM InfoNet database results identify occurrences of the species on Groote Eylandt.</p>



Common Name	Scientific Name	Conservation Status <sup>1</sup>		Database Records		TOR Species	Habitat Requirements	Likelihood of Occurrence
		EPBC Act	TPWC Act	PMST <sup>2</sup>	NRM InfoNet			
Salt-water Crocodile	<i>Crocodylus porosus</i>	M(m)		X			<p><b>General habitat requirements/preferences:</b> The Salt-water crocodile inhabits tidal rivers, coastal floodplains and channels, billabongs and swamps. It may be found up to 150 km inland from the coast, in habitats where salinity levels are sufficient (DotE, 2013k).</p> <p><b>Foraging requirements/preferences:</b> Primary food sources for the Salt-water Crocodile are crustaceans, insects and mammals. In high salinity, more crabs are consumed, while in freshwater, more insects are consumed (DotE, 2013k).</p> <p><b>Requirements/preferences for shelter sites:</b> The species is often found exposed in the mid-day sun, but under cover and shaded during the morning and late evening (DotE, 2013k).</p> <p><b>Breeding requirements/preferences:</b> Preferred nesting habitat for the species include isolated freshwater swamps that do not have tidal fluctuations (DotE, 2013k).</p>	<p><b>Present.</b> Recorded in the tributaries of the Amagula River within the southern EL during the EIS survey. The species was observed within a tributary of the Amagula River.</p> <p>This species has also been recorded during previous surveys by URS (2012) and Webb (1992), however the exact location is unknown.</p>

1 EPBC Act Status / TPWC Act Status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory (m) = marine, (t) = terrestrial, (w) = wetland]

2 EPBC Protected Matter Search Tool



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*Appendix G*

**Vegetation Community Profiles and Fauna  
Survey Site Descriptions**


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Table G.1 Vegetation Community Profiles

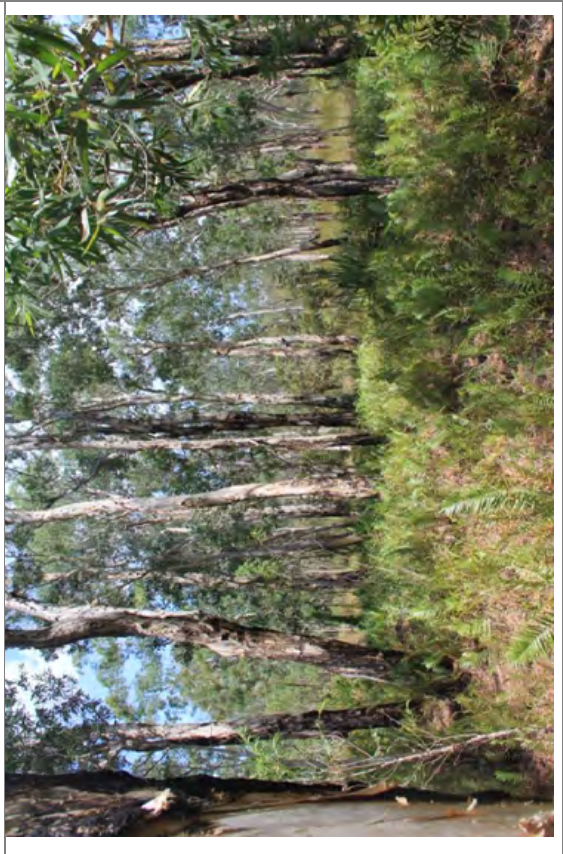
<b>Dry sub-coastal (inland) monsoon vine forest</b>	
<b>Map Unit:</b> MU3 <b>Survey Sites:</b> V27 <b>Fauna Habitat Type:</b> Closed forest (rainforest)	
<b>Location and Distribution</b>	This community was originally described by Webb (1992). This community was recorded in the Southern EL near the southern-most boundary near Amagula River – Tributary 1. It occurs as a small patch of vegetation on a substrate of surface rocks and gravel, with organic material and debris on the rock surface. The community occurs on a lens of shallow groundwater and may provide protection from fire.  This community is closely allied with the Dry Coastal Monsoon Vine Closed Forest (i.e. Map Unit 2), which was also described by Webb (1992).
<b>Vegetation Description</b>	The dominant tree species in this community is <i>Canarium australianum</i> . <i>Maranthes corymbosa</i> and <i>Ficus racemosa</i> were also common in the canopy. The understorey is also made up of regenerating trees species and vines including <i>Aglaia brownii</i> , <i>Myristica insipida</i> , <i>Celtis philippensis</i> , <i>Flagellaria indica</i> and <i>Diospyros maritima</i> .  The ground cover is a thick layer of litter and decomposing branches/trees. Grasses were absent. Other common species include <i>Ficus scobina</i> , <i>Dioscorea bulbifera</i> , <i>Meiogyne cylindrocarpa</i> , <i>Sterculia quadrifida</i> and <i>Glycosmis trifoliata</i> .
<b>Conservation Significance</b>	<ul style="list-style-type: none"> <li>The community is recognised as significant vegetation (Dry Monsoon Rainforests) under the Northern Territory Land Clearing Guidelines (NRETAS, 2010b); however it is not listed as significant or threatened under the EPBC Act.</li> </ul>
<b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b>	<ul style="list-style-type: none"> <li>The vegetation condition at this site was assessed as stable. The surrounding vegetation has been fire-affected although the vine forest seems to be sheltered from fire and shows little signs of fire damage; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>

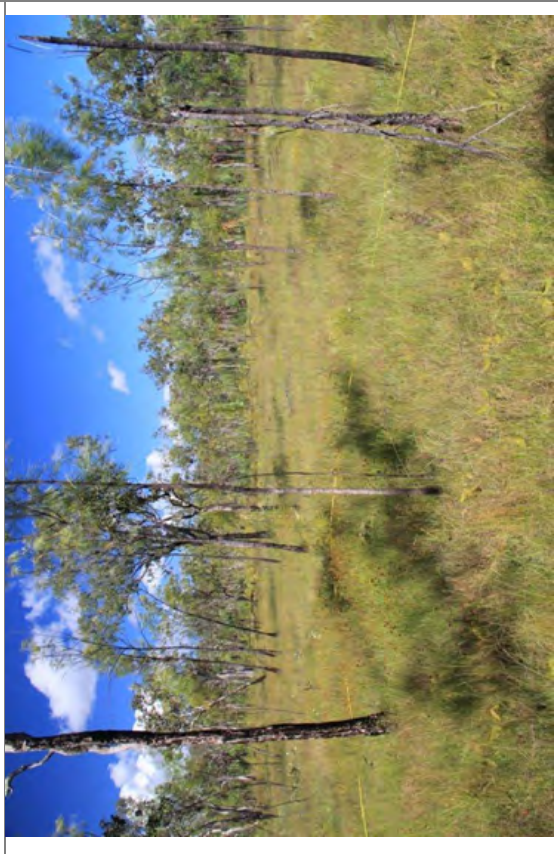
<p><b><i>Eucalyptus tetradonta</i> / <i>Eucalyptus miniata</i> open forest with low shrub or tussock grass understorey</b></p> <p><b>Map Unit:</b> MU4</p> <p><b>Survey Sites:</b> V1C, V2C, V3, V4, V9, V10, V11, V14, V15, V18, V19, V20, V21, V35, V36, V37, V38, V41, V42, V46, V52</p> <p><b>Fauna Habitat Type:</b> Open forest</p>	<p><b>Location and Distribution</b> This community is the dominant vegetation community on the project site. Soils are generally loamy sands and gravel may be present. This community occurs on the plains and rises of the project site and is associated with <i>Eucalyptus tetradonta</i>/ <i>Eucalyptus miniata</i> woodland (Map Unit 17).</p> <p><b>Vegetation Description</b> <i>Eucalyptus tetradonta</i> is the dominant canopy species with <i>Eucalyptus miniata</i> as sub-dominant. <i>Eucalyptus miniata</i> may be absent on some sites and is often replaced with <i>Corymbia</i> spp. Adjacent to creek lines, <i>Eucalyptus confertiflora</i>, <i>Eucalyptus bigalerita</i> and <i>Corymbia polycarpa</i> can be present.</p> <p>The midstorey is made of regenerating canopy species and other woody species such as <i>Erythrophleum chlorostachys</i>, <i>Pandanus spiralis</i>, <i>Petalostigma pubescens</i>, <i>Petalostigma banksii</i>, <i>Acacia</i> spp., and <i>Buchanania obovata</i>. <i>Owenia vernicosa</i> and <i>Cycas arnhemica</i> are occasionally present.</p> <p>The understorey is a tussock grassland including <i>Heteropogon triticeus</i> and <i>Sorghum</i> spp.. Other understorey species include regenerating midstorey species.</p>
	
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is recognised as significant vegetation (Old-growth Forest) under the Northern Territory Land Clearing Guidelines (NRETAS, 2010b); however it is not listed as significant or threatened under the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation conditions at this site varied throughout its range. This community generally displayed impacts from fire but was otherwise stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	

<p><b><i>Eucalyptus tetrodonta</i> / <i>Eucalyptus miniata</i> / <i>Callitris intratropica</i> open forest with mixed shrub / tussock grass understorey</b></p>	<p><b>Location and Distribution</b> This community occurs in the Southern EL in areas adjacent to or extending into the sandstone hills and plateaux. Sandstone rock outcrops are common in this community. Soils are generally shallow, gravelly and often rocky clayey sand over quartz sandstone.</p>
<p><b>Map Unit:</b> MU5 <b>Survey Sites:</b> V32 <b>Fauna Habitat Type:</b> Open forest</p>	<p>This community is floristically similar to Map Unit 4; however <i>Callitris intratropica</i> is dominant due to the higher sand composition of the soils. Small stands of almost pure <i>Callitris intratropica</i> may be present in this community (i.e. Map Unit 8) but have not been mapped due to their very small areas.</p>
	<p><b>Vegetation Description</b> <i>Eucalyptus tetrodonta</i> is the dominant canopy species with <i>Eucalyptus miniata</i> or <i>Callitris intratropica</i> as co-dominant or sub-dominant (15 – 18 m). <i>Eucalyptus miniata</i> may be absent on some sites. Stands of <i>Callitris intratropica</i> may occur. <i>E.ferruginea</i> and <i>Corymbia polycarpa</i> may also be present.</p> <p>The midstorey is made of regenerating canopy species and few other woody species such as <i>Erythrophleum chlorostachys</i>, <i>Pandanus spiralis</i>, <i>Petalostigma pubescens</i> <i>Acacia</i> spp., and <i>Buchanania obovata</i>.</p> <p>The understorey varies between low tussock dominated grassland and hummock grassland or commonly low shrubland of <i>Acacia</i> spp.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is recognised as significant vegetation (Old-growth Forest) under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b); however it is not listed as significant or threatened under the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable although some sites showed signs of impacts from fire; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	

<p><b>Melaleuca viridiflora / Corymbia polycarpa open forest with Pandanus spiralis and mixed tussock grassland understorey</b></p>	<p><b>Location and Distribution</b> Webb (1992) describes this community as occurring on the landward side of coastal dune systems and along drainage lines. Within the project site, this community generally occurs where drainage is impeded and may be seasonally inundated. Soils are generally firm dark brown to brown reddish loamy sands.</p> <p>This community often intergrades into <i>Eucalyptus tetrodonta</i> woodlands and open forests (Map Unit 4 and 17) and other vegetation that is seasonally inundated (including Map Unit 15a, 16, 24, and 31). It also often occurs on the fringes of swamps.</p>
<p><b>Map Unit:</b> MU10a</p> <p><b>Survey Sites:</b> V12, V13, V33, V50, V55</p> <p><b>Fauna Habitat Type:</b> Seasonal Wetland</p> 	<p><b>Vegetation Description</b> <i>Melaleuca viridiflora</i> is the dominant canopy species with emergent <i>Corymbia polycarpa</i> and <i>Pandanus spiralis</i>. Occasionally, <i>Corymbia confertiflora</i> is present in the canopy.</p> <p>The midstorey is made of regenerating canopy species and <i>Pandanus spiralis</i>. Some sites may also support <i>Banksia dentata</i>, <i>Melaleuca cajuputi</i>, <i>Terminalia carpentariae</i>, <i>Grevillea pteridifolia</i> and <i>Grevillea heliosperma</i> on the margins.</p> <p><i>Asteromyrtus symphyocarpa</i>, <i>Hakea arborescens</i>, <i>Erythrophleum chlorostachys</i> and <i>Buchanania obovata</i> may also be present in a shrub layer.</p> <p>The understorey is dominated by tussock grasses comprised of <i>Heteropogon</i> spp. and <i>Eriachne</i> spp. and may contain regenerating <i>Melaleuca viridiflora</i>.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b) or the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable although some sites showed signs of impacts from fire; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	


<b>Melaleuca viridiflora open forest and mixed tussock grassland understorey</b>		<p><b>Location and Distribution</b> This is a subset of the Map Unit 10 that was described by Webb (1992) where the canopy is almost completely made up of <i>Melaleuca viridiflora</i>. This community occurs in small isolated areas, typically associated with Map Units 10a and 31. Soils are generally firm dark brown to brown reddish loamy sands.</p> <p>Webb (1992) recognises pure stands of <i>Melaleuca viridiflora</i> within Map Unit 10 but did not map it as a distinct unit. The pure <i>Melaleuca viridiflora</i> stands appear to be located in areas where the depth to the water table is between 1-4 metres and water is likely to pool during seasonal inundation. The EIS Groundwater Report provides further detail on shallow groundwater within the project site.</p>
<p><b>Map Unit:</b> MU10b</p> <p><b>Survey Sites:</b> V54</p> <p><b>Fauna Habitat Type:</b> Seasonal Wetland</p>		<p><b>Vegetation Description</b> The canopy in this community is made up almost entirely of <i>Melaleuca viridiflora</i> (12 to 15 m). There is generally no midstorey but a few individuals of <i>Acacia</i> spp. can sometimes be present.</p> <p>The understorey is dominated by tussock grasses comprised of <i>Heteropogon</i> spp. and <i>Eriachne</i> spp. <i>Asteromyrtus symphyocarpa</i> may also be present in a shrub layer.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b) or the EPBC Act.</li> </ul>		
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>		


<p><b>Melaleuca leucadendra / Dillenia alata open forest with fern / sedge understorey</b></p>	<p><b>Location and Distribution</b> This community is a riparian vegetation community occurring along the downstream sections of the Emerald River – Tributary 2 within the Southern EL and the downstream section of the Amagula River – Tributary 1 within the Southern EL. Soils are brownish black to dark black sandy clay loams to silty loams.</p>
<p><b>Map Unit:</b> MU11  <b>Survey Sites:</b> V28, V29, V44  <b>Fauna Habitat Type:</b> Riparian</p>	<p>In at least two small areas of this community, elements of rainforest and vine-forest are present and are likely to be sustained by permanent springs.</p>
	<p><b>Vegetation Description</b> <i>Melaleuca leucadendra</i> is the dominant canopy species and can grow to 22 m. Other tall trees include <i>Dillenia alata</i>, <i>Canarium australianum</i>, <i>Syzygium nervosum</i> and <i>Melaleuca cajuputi</i>. <i>Eucalyptus tetrodonta</i> and <i>Acacia lamprocarpa</i> occur on its margins.</p> <p>In some areas of this community, there is no midstorey. The midstorey trees, where present, include regenerating canopy trees and other species such as <i>Alphitonia excelsa</i>, <i>Pandanus spiralis</i>, <i>Flagellaria indica</i>, <i>Carallia brachiata</i> and <i>Melastoma malabathricum</i>.</p> <p>The understorey is sparse however includes the ferns <i>Blechnum indicum</i>, <i>Stenochlaena palustris</i> and <i>Lygodium flexuosum</i>. Grasses recorded include <i>Eriachne spp.</i>.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is recognised as significant vegetation (Riparian Vegetation) under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b); however it is not listed as significant or threatened under the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	


<p><b>Melaleuca cajuputi</b> low closed forest / <b>Leptocarpus</b> sedgeland / closed sedgeland (permanent swamps/sedgeland)</p>	<p><b>Location and Distribution</b> This community is described by Webb (1992) as occurring landward of sand dunes, or in seasonal freshwater swamps. Within the project site, this community is not very extensive and generally occurs in association with areas of seasonal overland sheet flow, in the headwaters of the Emerald River – Tributary 2. Soils are brownish black to dark black sandy clay loams to silty loams.</p> <p>This community grades into <i>Melaleuca</i> forest and woodland communities (Map Unit 10a, 10b) and <i>Eucalyptus tetradonta</i> forest and woodland communities (Map Unit 4, 16, 17, and 24).</p>
<p><b>Map Unit:</b> MU15a  <b>Survey Sites:</b> None  <b>Fauna Habitat Type:</b> Seasonal Wetland</p> 	<p><b>Vegetation Description</b> In the project site, this community generally does not have a well developed overstorey, although <i>Corymbia polycarpa</i> and <i>Eucalyptus tetradonta</i> can sometimes be present as emergent or regenerating trees.</p> <p>This community also generally has no midstorey, although <i>Melaleuca</i> spp. and <i>Grevillea pteridifolia</i> are present in low numbers. <i>Banksia dentata</i> and <i>Asteromyrtys symphyocarpa</i> are occasional shrub species.</p> <p>The understorey is the dominant strata in this vegetation community. The understorey is dominated by sedges and grasses including <i>Schizachyrium</i> spp., <i>Thaumastochloa</i> spp., <i>Scleria</i> spp. and <i>Fimbristylis</i> spp..</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b) or the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	


<p><b><i>Eucalyptus tetrodonta</i> low open forest / woodland with low tree or <i>Sorghum interjectum</i> tussock grassland understorey</b></p>	<p><b>Map Unit:</b> MU16 <b>Survey Sites:</b> V23, V25, V34, V48, V51 <b>Fauna Habitat Type:</b> Woodland / shrubland</p>		<p><b>Location and Distribution</b> This community occurs within the project site predominantly in areas with a depth to ground water of 1-8 m, on shallow soils where drainage is impeded. Soils are generally firm dark brown to brown reddish loamy sands. This is a community that is floristically similar to Map Unit 23 described by Webb (1992), except that this community is a naturally occurring low open forest / woodland rather than regenerating after land clearance.</p>	<p><b>Vegetation Description</b> This community is a low tree woodland or low open forest. It is striking in that it features a very low and dense overstorey layer comprising regenerating or stunted <i>Eucalyptus tetrodonta</i>. Some <i>Eucalyptus tetrodonta</i>, <i>Pandanus spiralis</i> and <i>Grevillea</i> spp. are present as emergent trees.</p> <p>Other commonly occurring tree / shrub species include <i>Pandanus spiralis</i>, <i>Banksia dentata</i>, <i>Acacia lamprocarpa</i> and <i>Terminalia carpentariae</i>. Less frequent shrub species include <i>Persoonia falcata</i>, <i>Hakea arborescens</i>, <i>Grevillea pteridifolia</i>, <i>Grevillea heliosperma</i> and <i>Buchanania obovata</i>.</p> <p>The understorey is dominated by sedges and grasses including <i>Sorghum interjectum</i>, <i>Schizachyrium</i> spp., <i>Thaumastochloa</i> spp., <i>Scleria</i> spp. and <i>Fimbristylis</i> spp..</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the Northern Territory Land Clearing Guidelines (NRETAS. 2010b) or the EPBC Act.</li> </ul>				
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>				




<p><b><i>Eucalyptus tetrodonta</i> / <i>Eucalyptus miniata</i> / <i>Eucalyptus polycarpa</i> woodland with low shrub or tussock / hummock grass understorey</b></p> <p><b>Map Unit:</b> MU17</p> <p><b>Survey Sites:</b> V31, V43, V47</p> <p><b>Fauna Habitat Type:</b> Woodland / shrubland</p>	<p><b>Location and Distribution</b> This community has been reported to occur along banks of the major rivers, in particular the Angurugu River (Webb, 1992). Within the project site, this community was recorded as large patches of woodland in association with the Emerald River tributaries and Amagula River –Tributary 1, near the confluence with their respective main channels. Soils are generally firm dark brown to brown reddish loamy sands.</p> <p>This community is associated with <i>Eucalyptus tetrodonta</i> open forests (Map Unit 4). It is floristically very similar to Map Unit 4 except that it expressed as a woodland community rather than an open forest community and occurs on soils that are less well drained.</p>
	<p><b>Vegetation Description</b> <i>Eucalyptus tetrodonta</i> is the dominant canopy species (to 14 m). <i>Eucalyptus miniata</i> and <i>Corymbia polycarpa</i> occur as sub-dominant species.</p> <p>The midstorey was dominated by tree / shrub species including <i>Petalostigma pubescens</i>, <i>Pandanus spiralis</i>, <i>Cycas arnhemica</i>, <i>Acacia auriculiformis</i> and <i>Acacia lamprocarpa</i>. Other species that can occur in the midstorey include <i>Erythrophleum chlorostachys</i>, <i>Banksia dentata</i> and <i>Grevillea pteridifolia</i>.</p> <p>The understorey is dominated by common tussock grasses including <i>Heteropogon</i> spp., <i>Eriachne</i> spp. and <i>Schizachyrium</i> spp.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS. 2010b) or the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable although some sites showed signs of impacts from fire; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	



<p><b><i>Callitris intratropica</i> / <i>Eucalyptus tetradonta</i> / <i>Eucalyptus kombolgiensis</i> woodland to open woodland with hummock grassland understorey</b></p> <p><b>Map Unit:</b> MU18</p> <p><b>Survey Sites:</b> V5, V6, V7, V8, V24, V26, V45, V53</p> <p><b>Fauna Habitat Type:</b> Sandstone woodland and rock outcrop</p>	<p><b>Location and Distribution</b> Webb (1992) located this community on sandy areas, low sandstone hills and the side-slopes of the sandstone plateaux. Soils are shallow, if non-existent, gravelly and often rocky clayey sand over quartz sandstone.</p> <p>This community was widespread within the project site and was found on shallow, sandy soils with exposed areas of bare rock in association with low sandstone hills and plateaux.</p>
	<p><b>Vegetation Description</b> <i>Callitris intratropica</i>, <i>Corymbia kombolgiensis</i> and <i>Eucalyptus tetradonta</i> were the dominant canopy species.</p> <p>The midstorey was largely absent at this site however Webb (1992) reports that it can include regenerating canopy species. Midstorey species recorded included <i>Petalostigma banksii</i> and <i>Calytrix brownii</i>.</p> <p>The understorey is generally hummock grassland with scattered low shrubs, although tussock grasses were also present.</p> <p>Areas of bare rock / rocky outcrops were present.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS. 2010b) or the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable although some sites showed signs of impacts from fire; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	

<p><b><i>Melaleuca viridiflora</i> / <i>Eucalyptus polycarpa</i> / <i>Grevillea pteridifolia</i> woodland with <i>Asteromyrtus symphyocarpa</i> and <i>Vetiveria elongata</i> tussock grassland</b></p>	<p><b>Location and Distribution</b> This community is described by Webb (1992) as being associated with drainage depressions and seasonally inundated flow-on areas. This community is present on the project site in association with small, seasonally dry and shallow creeks. At these sites, lateritic rock is exposed in the creek beds and the surrounding areas become inundated during the wet season. Soils are generally brownish black to dark brown sandy clay loams.</p>
<p><b>Map Unit:</b> MU20  <b>Survey Sites:</b> V16, V22, V39, V49, V56  <b>Fauna Habitat Type:</b> Riparian</p>	<p>This community has affinities with <i>Melaleuca viridiflora</i> open forest communities (Map Unit 10a and 10b). The community is typically narrow and grades quickly into <i>Eucalyptus tetradonta</i> open forest and woodlands.</p>
	<p><b>Vegetation Description</b> <i>Melaleuca viridiflora</i>, <i>Corymbia polycarpa</i> and <i>Grevillea pteridifolia</i> dominate the canopy. Other canopy species recorded included <i>Eucalyptus tetradonta</i>. In some areas, there are no canopy trees. The midstorey was dominated by <i>Acacia</i> spp., <i>Asteromyrtus symphyocarpa</i> and regenerating canopy species. Other species recorded included <i>Erythrophleum chlorostachys</i>, <i>Pandanus spiralis</i>, and <i>Petalostigma pubescens</i>. The understorey was dominated by tussock grasses including <i>Heteropogon</i> spp. and <i>Sorghum</i> spp., and short grasses including <i>Eriachne</i> spp., <i>Schizachrium</i> spp., and <i>Thaumatococcus major</i>.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is recognised as significant vegetation (Riparian Vegetation) under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b); however it is not listed as significant or threatened under the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	




<p><b><i>Eucalyptus tetrodonta</i> / <i>Eucalyptus polycarpa</i> / <i>Melaleuca viridiflora</i> low open woodland with <i>Asteromyrtus symphyocarpa</i> shrubland</b></p>	<p><b>Location and Distribution</b> This community is described by Webb (1992) as occurring in association with intermittent creeks and dry creek lines. Within the project site, this community is not very extensive and generally occurs in association with areas of seasonal overland sheet flow, in the headwaters of the Emerald River – Tributary 2. Soils are generally shallow, firm dark brown to brown reddish loamy sands.</p> <p>This community grades into <i>Melaleuca</i> forest, woodland and sedgeland communities (Map Units 10a, 10b, 15a) and <i>Eucalyptus tetrodonta</i> forest and woodland communities (Map Units 4, 16, 17).</p>
<p><b>Map Unit:</b> MU24</p> <p><b>Survey Sites:</b> None</p> <p><b>Fauna Habitat Type:</b> Seasonal Wetland</p>	
	<p><b>Vegetation Description</b> In the project site, <i>Eucalyptus tetrodonta</i>, <i>Corymbia polycarpa</i> and <i>Melaleuca viridiflora</i> occur as emergent or regenerating trees.</p> <p>The main stratum is generally the shrub layer, which is dominated by regenerating <i>Melaleuca viridiflora</i> and <i>Grevillea pteridifolia</i>. <i>Banksia dentata</i>, <i>Grevillea heliosperma</i> and <i>Asteromyrtus symphyocarpa</i> are occasional shrub species.</p> <p>The understorey is dominated by sedges and grasses including <i>Schizachyrium</i> spp., <i>Thaumastochloa</i> spp., <i>Scleria</i> spp. and <i>Fimbristylis</i> spp.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b) or the EPBC Act.</li> </ul> <p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	




<p><b><i>Eucalyptus tectifica</i> open woodland with mixed shrub / tussock grass understorey</b></p>	<p><b>Location and Distribution</b> This is an open woodland that is dominated by <i>Corymbia tectifica</i>. Within the project site, this community generally occurs where drainage is impeded and may be seasonally inundated. Soils are firm dark brown to brown reddish loamy sands.</p>
<p><b>Map Unit:</b> MU31</p> <p><b>Survey Sites:</b> V17, V30, V40</p> <p><b>Fauna Habitat Type:</b> Woodland / shrubland</p>	<p>This community often intergrades into <i>Eucalyptus tetradonta</i> woodlands and open forests (Map Unit 4 and 17) and other vegetation that is seasonally inundated (including Map Unit 10a, 10b, 15a, 16 and 24).</p>
	<p><b>Vegetation Description</b> The canopy layer in this community is dominated by <i>Corymbia tectifica</i> (to 10 m). <i>Corymbia confertiflora</i> is sometimes present as an occasional canopy species.</p> <p>The midstorey is generally absent from this community. Shrub species present include <i>Acacia lamprocarpa</i>, <i>Buchanania obovata</i>, <i>Erythrophleum chlorostachys</i>, <i>Brachychiton paradoxa</i> and <i>Kailarsenia suffruticosa</i>.</p> <p>The ground stratum is dominated by grass species, including <i>Thaumastochloa major</i>, <i>Sorghum plumosum</i>, <i>Setaria apiculata</i> and <i>Mnesithea rottboellioides</i>.</p>
<p><b>Conservation Significance</b></p> <ul style="list-style-type: none"> <li>The community is not recognised as significant vegetation under the <i>Northern Territory Land Clearing Guidelines</i> (NRETAS. 2010b) or the EPBC Act.</li> </ul>	
<p><b>Vegetation Condition and Presence of Declared Weeds or Naturalised Species</b></p> <ul style="list-style-type: none"> <li>The vegetation condition at this site was found to be stable however impacts from fire were evident and some tree death was recorded; and</li> <li>No declared weeds or naturalised species were recorded at this site.</li> </ul>	

**Table G.2 Description of Vegetation and Habitat at Fauna Survey Sites**

Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA1  <b>Location:</b> Northern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 664763E            8448757N</p>	<p>Located within open forest with a dense shrub and grass understorey, with a canopy dominated by <i>Eucalyptus tetradonta</i> and <i>E. miniata</i>. No specimens were blossoming at the time of the survey. No logs, hollows, or piles of rocks were present at the site. No water was present near the site.</p>	
<p><b>Site:</b> FA2  <b>Location:</b> Northern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 664048E            8447577N</p>	<p>Located within open forest with a grassy understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i> nearby to Melaleuca riparian vegetation. No specimens were blossoming at the time of the survey. The Emerald River was immediately adjacent to the site and was flowing at the time of the survey. Habitat features present include fallen logs, dense understorey, and flowing water.</p>	









Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA3  <b>Location:</b> Northern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 665899E                      8447213N</p>	<p>Located within open forest with an open shrub and grass understorey. The canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. No specimens were blossoming at the time of the survey. A large rocky outcrop was present nearby the site. Other fauna habitat features include the Emerald River (ephemeral at this location and not flowing at the time of the survey) with pools of water, as well as fallen logs nearby the river bed.</p>	
<p><b>Site:</b> FA4  <b>Location:</b> Southern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 662173E                      8442501N</p>	<p>Located in a sparse sandstone woodland with extensive rocky outcrops. The canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. No specimens were blossoming at the time of survey. Fauna habitat features included a labyrinth of caves and tunnels within the rocky ridgeline. Fallen logs and trees with hollows were also present at the site. No water was present near the site.</p>	
<p><b>Site:</b> FA5  <b>Location:</b> Southern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 665353E                      8440026N</p>	<p>Located in a dense rainforest and monsoon vine thicket with a closed canopy and rocky soils. No specimens were blossoming at the time of survey. The understorey was sparse and vegetative ground cover was almost absent at the site. No fallen logs were observed at this site. No water was present near the site.</p>	

Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA6  <b>Location:</b> Southern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 663332E  8442506N</p>	<p>Located in stunted open forest with a dense shrub and grass understorey. The canopy was predominately absent, with scattered stunted <i>E. miniata</i> and <i>E. tetradonta</i> with mixed tussock grass understorey. No specimens were blossoming at the time of survey. Fauna habitat features present include a dense grass layer and low shrub layer. No fallen logs or permanent water was present at the site.</p>	
<p><b>Site:</b> FA7  <b>Location:</b> Southern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 665449E  8440448N</p>	<p>Located within open forest with a shrub and grass understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. No specimens were blossoming at the time of survey. Located adjacent to a flowing tributary of the Amagula River, the site occurs along an ecotone between open- and riparian woodlands. Fallen logs were also present at the site.</p>	
<p><b>Site:</b> FA8  <b>Location:</b> Southern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 668631E  8440755N</p>	<p>Located within open forest with an open low shrub and grass understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. No specimens were blossoming at the time of survey. Faunal habitat features include fallen logs and a dense shrub and grass layer. A tributary of the Amagula River containing large isolated pools was noted to be situated within 50m of the site.</p>	


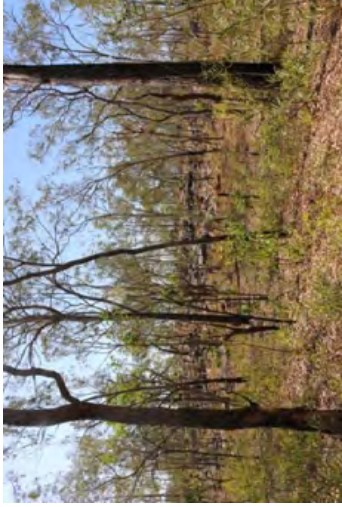
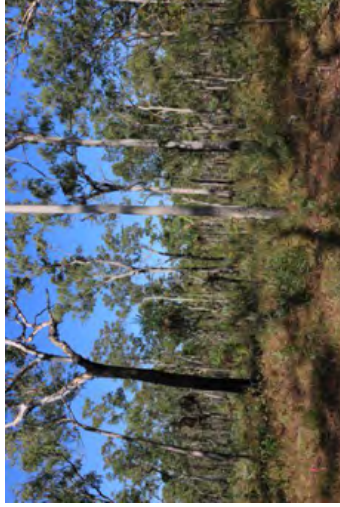





Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA9  <b>Location:</b> Southern EL  <b>Surveyed:</b> May / June 2014  <b>Coordinates:</b> 667475E                      8440470N</p>	<p>Located within open forest with a very dense shrub / grassy understorey, with a canopy dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. No specimens were blossoming at the time of the survey. Habitat features recorded include fallen logs. No water was present near the site.</p>	
<p><b>Site:</b> FA10  <b>Location:</b> Southern EL  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 663269E                      8444278N</p>	<p>Located within open forest with a low density shrub and grass understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include fallen logs, and dense grass layer. No water was present near the site.</p>	
<p><b>Site:</b> FA11  <b>Location:</b> Southern EL  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 665320E                      8442386N</p>	<p>Located within open forest with a low density shrub and small tree layer, with large areas of annual grasses. The canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include occasional fallen logs and grass layer. No water was present near the site at the time of survey.</p>	

Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA12  <b>Location:</b> Southern EL  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 668228E  8442029N</p>	<p>Located within open forest with a dense shrub understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include fallen logs and a deep grassy understorey. No water was present near the site.</p>	
<p><b>Site:</b> FA13  <b>Location:</b> Southern EL  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 663002E  8441019N</p>	<p>Located within open forest with an open shrub and grass understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i> with occasional <i>Callitris intratropica</i> dominating nearby. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include a large rocky outcrop nearby the site and fallen logs. No water was present near the site.</p>	
<p><b>Site:</b> FA14  <b>Location:</b> Southern EL  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 659917E  8443235N</p>	<p>Located within open forest with a variable density shrub understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Occasional <i>Brachychiton</i> blossoms were present. The site also has Fauna habitat features include fallen logs and deep grassy understorey. No water was present near the site.</p>	



Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA15  <b>Location:</b> Haul Rd Corridor  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 660857E                      8446564N</p>	<p>Located in an extensive area of sparse <i>E. tectifica</i> woodland. Very limited large trees containing hollows were present, and most trees were small stunted trees or shrubs. The site had a sparse groundcover stratum with limited logs. Rocky soil dominates, with large bare patches also present. No water was present near the site.</p>	
<p><b>Site:</b> FA16  <b>Location:</b> Haul Rd Corridor  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 659299E                      8447015N</p>	<p>Located within open forest with an open shrub and grass understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include a large rocky outcrop located nearby the site, fallen logs. Limited groundcover was present but a high litter load was noted. No water was present near the site.</p>	
<p><b>Site:</b> FA17  <b>Location:</b> Haul Rd Corridor  <b>Surveyed:</b> October 2014  <b>Coordinates:</b> 662074E                      8448141N</p>	<p>Located within open forest with an open, occasionally shrubby understorey, with a canopy dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Large trees were noted surrounding the site, and rocky hills were located to the north. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include fallen logs and a deep grassy understorey. No water was present near the site.</p>	

Site Details	Vegetation and Habitat Description	Representative Photograph
<p><b>Site:</b> FA18</p> <p><b>Location:</b> Northern EL</p> <p><b>Surveyed:</b> October 2014</p> <p><b>Coordinates:</b> 662992E 8449823N</p>	<p>Located within open forest with an occasionally shrubby understorey, the canopy was dominated by <i>E. tetradonta</i> and <i>E. miniata</i>. Large were noted trees surrounding the site, and rocky hills were located to the north. Occasional <i>Brachychiton</i> blossoms were present. Fauna habitat features include fallen logs and a deep grassy understorey. No water was present near the site.</p>	



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*Appendix H*

# Flora Species List

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Vegetation Community Number (Map Unit)

Family	Scientific Name	STATUS	MU3	MU4	MU5	MU10a	MU10b	MU11	MU15a	MU16	MU17	MU18	MU20	MU24	MU31
Fabaceae (Mimosoideae)	<i>Acacia auriculiformis</i>	-	0	1	1	0	0	1		1	1	0	1		0
Fabaceae (Mimosoideae)	<i>Acacia diffusa</i>	-	0	0	1	0	0	0		0	0	0	0		0
Fabaceae (Mimosoideae)	<i>Acacia holosericea</i>	-	0	0	0	0	0	1		0	0	0	0		0
Fabaceae (Mimosoideae)	<i>Acacia lamprocarpa</i>	-	0	1	1	1	0	1		1	1	1	1		1
Fabaceae (Mimosoideae)	<i>Acacia lateralis</i>	-	0	1	0	0	0	0		0	0	1	0		0
Fabaceae (Mimosoideae)	<i>Acacia orricarpa</i>	-	0	0	1	0	0	0		0	0	1	1		0
Fabaceae (Mimosoideae)	<i>Acacia simsii</i>	-	0	0	0	0	0	1		0	0	0	0		0
Fabaceae (Mimosoideae)	<i>Acacia sublanata</i>	-	0	0	0	0	0	0		0	0	1	0		0
Fabaceae (Mimosoideae)	<i>Acacia torulosa</i>	-	0	1	0	0	0	0		1	0	0	1		0
Fabaceae (Mimosoideae)	<i>Acacia yirrkalensis</i>	-	0	1	0	0	0	0		0	0	0	0		0
Passifloraceae	<i>Adenia heterophylla</i>	-	1	0	0	0	0	0		0	0	0	0		0
Meliaceae	<i>Aglala brownii</i>	-	1	0	0	0	0	0		0	0	0	0		0
Poaceae	<i>Allotropis semiolata</i>	-	0	1	1	0	0	0		1	0	1	1		1
Rhamnaceae	<i>Alphitonia excelisior</i>	-	0	1	0	0	0	1		1	0	1	1		1
Apocynaceae	<i>Alyxia spicata</i>	-	0	1	1	0	0	1		1	0	1	0		0
Viaceae	<i>Ampelocissus acetosa</i>	-	0	1	1	0	0	1		1	0	1	1		1
Viaceae	<i>Ampelocissus</i> sp.	-	0	0	0	0	0	0		0	0	0	1		0
Lamiaceae	<i>Anisomeles malabarica</i>	-	0	1	0	0	0	0		0	0	0	0		1
Lamiaceae	<i>Anisomeles</i> sp.	-	0	1	0	0	0	0		0	0	0	0		0
Santalaceae	<i>Anthobolus filifolius</i>	-	0	0	0	0	0	0		0	0	1	0		0
Phyllanthaceae	<i>Antidesma ghaesembilla</i>	-	0	1	0	1	0	0		0	0	0	1		0
Poaceae	<i>Aristida holathera</i>	-	0	1	0	0	0	0		0	0	0	1		0
Poaceae	<i>Aristida hygrometrica</i>	-	0	1	0	0	0	0		0	0	0	0		0
Asparagaceae	<i>Asparagus racemosus</i>	-	0	1	0	0	0	0		0	0	0	0		0
Myrtaceae	<i>Asteromyrtus symphyocarpa</i>	-	0	0	0	0	1	0		1	0	0	1		1
Restionaceae	<i>Baoboskion</i> (syn. <i>Restio</i> ) sp.	-	0	0	1	0	0	0		0	0	0	0		0
Proteaceae	<i>Banksia dentata</i>	-	0	0	0	0	0	0		0	1	0	0		0
Blechnaceae	<i>Blechnum indicum</i>	-	0	0	0	0	0	1		0	0	0	0		0
Rutaceae	<i>Boronia lanuginosa</i>	-	0	0	0	0	0	0		1	0	0	0		0
Fabaceae (Faboideae)	<i>Bossiaea bossiaoides</i>	-	0	1	0	0	0	0		0	0	1	0		0
Malvaceae	<i>Brachychiton diversifolius</i>	-	0	1	0	1	0	0		1	0	0	0		0
Malvaceae	<i>Brachychiton paradoxus</i>	-	0	1	1	1	0	1		1	0	1	1		1
Phyllanthaceae	<i>Breyeria cernua</i>	-	0	0	0	0	0	1		0	0	1	0		0
Euphorbiaceae	<i>Brodiaea tomentosa</i>	-	0	1	0	0	0	1		0	0	0	0		0
Acanthaceae	<i>Brunoniella australis</i>	-	0	1	0	0	0	0		0	0	0	0		0
Acanthaceae	<i>Brunoniella linearifolia</i>	-	0	0	0	0	0	0		0	0	0	0		1
Anacardiaceae	<i>Buchanania arborescens</i>	-	0	0	0	0	0	1		0	0	0	0		0
Anacardiaceae	<i>Buchanania obovata</i>	-	0	1	1	1	0	1		1	1	1	1		1
Linderniaceae	<i>Buchnera linearis</i>	-	0	1	0	0	0	0		0	0	1	0		1
Linderniaceae	<i>Buchnera tetragona</i>	-	0	0	0	1	0	0		0	0	0	0		0
Cyperaceae	<i>Bulbostylis barbata</i>	-	0	0	1	0	0	0		0	0	0	0		0
Fabaceae (Faboideae)	<i>Cajanus geminatus</i>	-	0	1	0	0	0	0		0	0	1	0		0
Cupressaceae	<i>Callitris intratropica</i>	-	0	1	1	0	0	0		0	0	1	0		0
Clusiaceae	<i>Calophyllum sij</i>	-	0	0	0	0	0	1		0	0	0	0		0
Burseraceae	<i>Canarium australianum</i>	-	1	1	0	0	0	0		0	0	1	0		0
Rhizophoraceae	<i>Carallia brachiata</i>	-	0	0	0	0	0	1		0	0	0	0		0
Commelinaceae	<i>Cartonema parviflorum</i>	-	0	0	0	0	0	0		0	1	0	0		0
Commelinaceae	<i>Cartonema spicatum</i>	-	0	1	0	0	0	0		0	0	1	1		1
Lauraceae	<i>Cassipoua filiformis</i>	-	0	1	0	0	0	0		1	0	1	0		0
Viaceae	<i>Cayratia acris</i>	-	1	0	0	0	0	0		0	0	0	0		0
Campanulaceae	<i>Celtis philippinensis</i>	-	1	0	0	0	0	0		0	0	0	0		0
Fabaceae (Caesalpinioideae)	<i>Chamaecrista nomame</i>	-	0	1	0	1	0	0		0	0	0	1		1
Pteridaceae	<i>Chelidanthus tenuifolia</i>	-	0	0	0	0	0	0		0	0	0	1		0
Poaceae	<i>Chrysopogon elongatus</i>	-	0	0	0	0	0	0		0	0	1	0		0
Poaceae	<i>Chrysopogon fallax</i>	-	0	0	0	1	0	0		0	0	0	0		0
Poaceae	<i>Chrysopogon</i> sp.	-	0	1	0	0	0	0		0	0	0	0		0
Lamiaceae	<i>Clerodendrum floribundum</i>	DD - var. <i>angustifolia</i> - var. <i>attenuatum</i>	0	1	0	1	0	1		0	0	0	0		0
Polygalaceae	<i>Comesperma aphyllum</i>	-	0	1	0	0	0	0		0	0	0	0		0
Commelinaceae	<i>Commelina ensifolia</i>	-	0	0	1	0	0	0		0	0	0	0		0
Myrtaceae	<i>Corymbia confertifolia</i>	-	0	0	0	1	0	0		0	0	0	0		1



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Myrtaceae	<i>Corymbia ferruginea</i>	-	0	1	0	0	0	0	0	0	0	0	1	0	0
Myrtaceae	<i>Corymbia polycarpa</i>	-	0	1	0	1	0	1	0	0	0	0	1	0	0
Fabaceae (Faboideae)	<i>Crotalaria brevis</i>	-	0	1	1	0	0	0	0	0	0	0	0	0	0
Euphorbiaceae	<i>Croton sp.</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Lauraceae	<i>Cryptocarya cunninghamii</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Cycadaceae	<i>Cycas arnhemica</i>	-	0	1	0	0	0	1	0	0	0	1	1	0	1
Poaceae	<i>Cymbopogon refractus</i>	-	0	0	1	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Cyperus sp.</i>	-	0	1	0	1	0	0	0	0	0	0	0	0	0
Calasfraceae	<i>Denhamia obscura</i>	-	0	1	1	0	0	0	0	0	0	0	0	0	0
Fabaceae (Faboideae)	<i>Desmodium trichostachyum</i>	-	0	0	1	0	0	0	0	0	0	0	0	0	1
Hemerocallidaceae	<i>Dianella longifolia</i>	-	0	1	0	0	0	1	0	1	0	1	1	0	1
Gleicheniaceae	<i>Dicranopteris linearis</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Dilleniaceae	<i>Dillenia alata</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Dioscoreaceae	<i>Dioscorea bulbifera</i>	-	1	0	0	0	0	1	0	0	0	0	0	0	0
Dioscoreaceae	<i>Dioscorea transversa</i>	-	0	1	0	0	0	1	0	0	0	0	0	0	0
Ebenaceae	<i>Diospyros maritima</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Sapindaceae	<i>Dodonaea hispidula</i>	-	0	1	0	0	0	0	1	0	0	1	0	0	0
Droseraceae	<i>Drosera indica</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Polyodiaceae	<i>Drynaria quercifolia</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Pitriaceae	<i>Drypetes deplanchei</i>	-	0	1	0	0	0	1	0	0	0	0	0	0	0
Elaeocarpaceae	<i>Elaeocarpus amhemicus</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Eriachne avenacea</i>	-	0	1	1	0	0	0	1	0	0	1	0	0	1
Poaceae	<i>Eriachne collaris</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Poaceae	<i>Eriachne holalthera</i>	-	0	0	1	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Eriachne obtusa</i>	-	0	0	0	0	0	0	0	1	0	0	0	0	0
Poaceae	<i>Eriachne schultzeana</i>	-	0	0	0	0	0	0	0	0	1	0	0	0	1
Poaceae	<i>Eriachne sp.</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Poaceae	<i>Eriachne trisetata</i>	-	0	1	0	1	0	1	0	1	1	1	1	0	1
Poaceae	<i>Erythroprium chlorostachys</i>	-	0	1	1	1	0	1	0	1	1	1	1	0	1
Fabaceae (Caesalpinioideae)	<i>Erythroxylum ellipticum</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Myrtaceae	<i>Eucalyptus kombolgiensis</i>	-	0	1	0	0	0	0	0	0	0	1	0	0	0
Myrtaceae	<i>Eucalyptus miniata</i>	-	0	1	1	0	0	0	0	0	0	0	0	0	0
Myrtaceae	<i>Eucalyptus tectifica</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrtaceae	<i>Eucalyptus tetradonta</i>	-	0	1	1	0	0	1	0	1	1	1	1	0	1
Euphorbiaceae	<i>Euphorbia bifida</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Convolvulaceae	<i>Evolvulus alsinoides</i>	DD - var. <i>alsinoides</i> , var. <i>sericeus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0
Santalaceae	<i>Exocarpos latifolius</i>	-	0	1	0	0	0	1	0	0	0	0	0	0	0
Santalaceae	<i>Exocarpos plectycarpus</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Moraceae	<i>Ficus atricha</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Moraceae	<i>Ficus racemosa</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Moraceae	<i>Ficus scobina</i>	-	1	0	0	0	0	1	0	0	0	0	0	0	0
Cyperaceae	<i>Fimbristylis punctata</i>	-	0	0	1	0	0	0	0	0	0	0	0	0	0
Cyperaceae	<i>Fimbristylis sp.</i>	-	0	0	0	1	0	0	0	1	1	0	0	0	0
Flagellariaceae	<i>Flagellaria indica</i>	-	1	0	0	0	0	1	0	0	0	1	0	0	0
Fabaceae (Faboideae)	<i>Flemingia parviflora</i>	-	0	1	0	0	0	0	0	0	1	0	1	0	0
Fabaceae (Faboideae)	<i>Flemingia trifoliarum</i>	-	0	1	0	1	0	0	0	0	0	0	0	0	0
Phyllanthaceae	<i>Flueggea virosa</i>	-	0	1	0	1	0	0	0	0	0	0	0	0	0
Rubiaceae	<i>Gardenia tucata</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Rubiaceae	<i>Gardenia schwarzii</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Orchidaceae	<i>Geodorum densiflorum</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Germinia grandiflora</i>	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Poaceae	<i>Germinia sp.</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Phyllanthaceae	<i>Glochidion xerocarpum</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Fabaceae (Faboideae)	<i>Glycine tomentella</i>	-	0	1	1	1	0	0	0	1	0	1	0	0	1
Rutaceae	<i>Glycosmis trifoliata</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Fabaceae (Faboideae)	<i>Gompholobium subulatum</i>	-	0	1	1	0	0	0	0	1	1	1	0	0	0
Haloragaceae	<i>Gonocarpus chinensis</i>	-	0	0	1	0	0	0	0	0	0	0	0	0	0
Haloragaceae	<i>Gonocarpus leptothecus</i>	-	0	1	0	0	0	0	0	1	0	0	0	0	0
Haloragaceae	<i>Gonocarpus sp.</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0



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Goodeniaceae	<i>Goodenia armstrongiana</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Goodeniaceae	<i>Goodenia pilosa</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Proteaceae	<i>Grevillea heliosperma</i>	-	0	1	0	0	0	0	1	1	0	1	1	0	0
Proteaceae	<i>Grevillea pteridifolia</i>	-	0	1	0	1	0	0	1	1	1	0	1	0	1
Proteaceae	<i>Grevillea pteridocarpa</i>	-	0	0	0	1	0	0	0	1	0	0	0	0	0
Proteaceae	<i>Grevillea pungens</i>	-	0	1	0	0	0	0	1	1	0	0	0	0	0
Malvaceae	<i>Grewia retusifolia</i>	-	0	1	0	1	0	0	0	0	0	0	1	0	1
Haemodioraceae	<i>Haemodorum brevicaulis</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Proteaceae	<i>Hakea erubescens</i>	-	0	1	0	1	0	0	1	1	0	0	0	0	1
Malvaceae	<i>Helicteres caria</i>	-	0	0	0	0	0	0	1	1	0	1	0	0	1
Boraginaceae	<i>Heliotropium bracteatum</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Boraginaceae	<i>Heliotropium ventricosum</i>	-	0	1	1	0	0	0	0	0	0	0	0	0	1
Poaceae	<i>Heteropogon triticeus</i>	-	0	1	0	1	0	0	1	1	0	0	1	0	1
Dilleniaceae	<i>Hibbertia campilanata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Dilleniaceae	<i>Hibbertia oblongata ssp. oblongata</i>	-	0	0	0	0	0	1	1	1	0	1	0	0	0
Dilleniaceae	<i>Hibbertia pilosa</i>	-	0	0	0	0	0	0	1	1	0	0	0	0	0
Dilleniaceae	<i>Hibbertia sp.</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Dilleniaceae	<i>Hibbertia sphenandra</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Malvaceae	<i>Hibiscus stenocladu</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Violaceae	<i>Hybanthus emmeaspermus</i>	-	0	1	0	0	0	1	1	1	0	1	0	0	1
Araceae	<i>Hydrastyle wendlandiana</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Imperata cylindrica</i>	-	0	1	0	1	0	0	0	0	0	0	0	0	0
Fabaceae (Faboideae)	<i>Indigofera sp.</i>	-	0	1	1	0	0	0	0	0	0	0	0	0	0
Oleaceae	<i>Jasminum elongatum</i>	-	0	1	0	1	0	0	0	1	0	0	1	0	1
Rubiaceae	<i>Kaialarsenia suffruticosa</i>	-	0	1	0	1	0	0	0	1	0	0	1	0	1
Restionaceae	<i>Lepyrodia sp.</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Lauraceae	<i>Listea glutinosa</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Araceae	<i>Livistona inermis</i>	-	0	1	0	0	0	0	0	0	0	1	0	0	0
Asparagaceae	<i>Lomandra tropica</i>	-	0	1	1	0	0	1	1	1	0	1	1	0	1
Myrtaceae	<i>Lophostemon laetifolius</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Rutaceae	<i>Luvunga monophylla</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Lygodiacae	<i>Lygodium flexuosum</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Euphorbiaceae	<i>Macaranga tanarius</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Chrysobalanaceae	<i>Maranthus corymbosa</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Apocynaceae	<i>Marsdenia viridiflora ssp. tropica</i>	-	0	1	0	0	0	0	0	0	0	1	0	0	0
Annonaceae	<i>Meiogyne cylindrocarpa</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Myrtaceae	<i>Melaleuca cajuputi</i>	-	0	0	0	0	0	1	1	1	0	0	1	0	0
Myrtaceae	<i>Melaleuca leucadendra</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Myrtaceae	<i>Melaleuca nervosa</i>	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Myrtaceae	<i>Melaleuca viridiflora</i>	-	0	1	0	1	1	1	1	1	0	0	1	0	0
Melastomataceae	<i>Melastoma malabathricum</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Rutaceae	<i>Meilicope (syn. Eucodia) elleryana</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Convolvulaceae	<i>Merrima quinata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Euphorbiaceae	<i>Microstachys chamaelea</i>	-	0	1	0	0	0	0	0	1	0	0	0	0	1
Loganiaceae	<i>Mitrasacme conriata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Loganiaceae	<i>Mitrasacme sp.</i>	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Poaceae	<i>Mnesithea tomosa</i>	-	0	1	1	0	0	0	1	1	0	0	0	0	1
Poaceae	<i>Mnesithea rotboelloides</i>	-	0	1	0	0	0	1	1	1	0	1	1	0	1
Commelinaceae	<i>Murdarrnia graminea</i>	-	0	1	0	0	0	0	1	1	1	0	0	0	0
Myristicaceae	<i>Myristica insipida</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Nelumbonaceae	<i>Nelumbo sp.</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Oplilaceae	<i>Opilia amentacea</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Meliaceae	<i>Owenia vernicosa</i>	-	0	1	0	0	0	0	0	0	0	1	0	0	0
Menispermaceae	<i>Pachygone ovata</i>	-	0	0	0	0	0	1	1	1	0	0	0	0	0
Pandanaceae	<i>Pandanus spiralis</i>	-	0	0	1	0	0	1	1	1	1	1	1	0	1
Poaceae	<i>Panicum mindanaense</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Proteaceae	<i>Pearsonia falcata</i>	-	0	1	1	0	0	0	0	1	1	1	1	0	1
Picrodendraceae	<i>Petalostigma banksii</i>	-	0	1	0	0	0	0	0	0	0	1	0	0	0
Picrodendraceae	<i>Petalostigma pubescens</i>	-	0	1	1	0	0	0	0	1	1	1	1	0	1
Phyllodraceae	<i>Phyllodium lanuginosum</i>	-	0	0	0	0	0	0	0	0	0	0	1	0	0





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Family	Scientific Name	STATUS	MU3	MU4	MU5	MU10a	MU10b	MU11	MU15a	MU16	MU17	MU18	MU20	MU24	MU31
Phyllanthaceae	<i>Phyllanthus</i> sp.	-	0	1	1	0	0	0	0	1	1	1	0	0	1
Sapotaceae	<i>Planchonella</i> (syn. <i>Pouteria</i> ) <i>arthenica</i>	-	0	1	0	0	0	1	0	1	0	1	1	0	0
Lecythidaceae	<i>Planchonia</i> <i>careva</i>	-	0	1	0	0	0	0	0	1	0	0	1	0	1
Lamiaceae	<i>Plectranthus</i> <i>scutellarioides</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Canophyllaceae	<i>Polycarpaea</i> sp.	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Polygalaceae	<i>Polygala</i> <i>coralliformis</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Polygalaceae	<i>Polygala</i> <i>obovata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Polygalaceae	<i>Polygala</i> <i>obovata</i>	-	0	0	1	0	0	0	0	0	0	1	0	0	0
Polygalaceae	<i>Polygala</i> <i>parviflora</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Polygalaceae	<i>Polygala</i> sp.	-	0	1	1	0	0	0	0	0	0	0	0	0	0
Convolvulaceae	<i>Polymnia</i> <i>ambigua</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	1
Lamiaceae	<i>Premna</i> <i>acuminata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	1
Poaceae	<i>Pseudopogonatherum</i> <i>irritans</i>	-	0	1	0	1	0	0	0	0	0	0	0	0	0
Cyperaceae	<i>Rhynchospora</i> sp.	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Acanthaceae	<i>Rostellularia</i> sp.	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Santalaceae	<i>Santalum</i> <i>lancofolium</i>	-	0	1	0	0	0	0	0	0	0	1	1	0	0
Phyllanthaceae	<i>Scaevola</i> <i>stenocladus</i> ssp. <i>stenocladus</i>	-	0	1	0	1	0	0	0	0	0	1	0	0	1
Poaceae	<i>Schizachyrium</i> <i>pachyrhizon</i>	-	0	1	1	1	0	0	0	1	1	1	1	0	1
Poaceae	<i>Schizachyrium</i> sp.	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Schizaceae	<i>Schizaea</i> <i>dichotoma</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Cyperaceae	<i>Scleria</i> <i>novae-hollandiae</i>	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Cyperaceae	<i>Scleria</i> <i>pygmaea</i>	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Cyperaceae	<i>Scleria</i> sp.	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Cyperaceae	<i>Scleria</i> <i>tricuspidata</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Poaceae	<i>Serima</i> sp.	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Sapotaceae	<i>Sersalisia</i> (syn. <i>Pouteria</i> ) <i>sericea</i>	-	0	0	0	0	0	1	0	0	0	1	0	0	0
Poaceae	<i>Setaria</i> <i>apiculata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	1
Malvaceae	<i>Sida</i> sp.	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Smilacaceae	<i>Smilax</i> <i>australis</i>	-	0	1	0	0	0	1	0	1	0	1	1	0	0
Poaceae	<i>Sorghum</i> (syn. <i>Sarga</i> ) <i>plumosum</i>	-	0	1	0	1	0	0	0	1	0	1	1	0	1
Poaceae	<i>Sorghum</i> (syn. <i>Sarga</i> ) <i>limosense</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubiaceae	<i>Spermacoe</i> <i>eliosoma</i>	-	0	1	1	1	0	0	0	1	0	1	1	0	1
Celastraceae	<i>Stackhousia</i> <i>intermedia</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Proteaceae	<i>Stenocarpus</i> <i>acacioides</i>	-	0	1	0	0	0	0	0	1	0	0	0	0	0
Blechnaceae	<i>Stenochlaena</i> <i>palustris</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Menispermaceae	<i>Stephania</i> <i>japonica</i>	DD - var. <i>japonica</i>	0	0	0	0	0	1	0	0	0	0	0	0	0
Malvaceae	<i>Sterculia</i> <i>quadrifida</i>	-	1	0	0	0	0	0	0	0	0	1	0	0	0
Stylidiaceae	<i>Styidium</i> <i>pachyrhizum</i>	-	0	0	0	0	0	0	0	0	1	0	0	0	0
Stylidiaceae	<i>Styidium</i> sp.	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Myrtaceae	<i>Syzygium</i> <i>nervosum</i>	-	0	0	0	0	0	1	0	0	0	0	0	0	0
Myrtaceae	<i>Syzygium</i> <i>suborbiculare</i>	-	0	0	0	0	0	0	0	1	0	0	1	0	0
Taccaceae	<i>Tacca</i> <i>leontopetaloides</i>	-	0	1	1	0	0	0	0	0	0	0	1	0	0
Fabaceae (Faboideae)	<i>Tephrosia</i> <i>luncea</i>	-	0	1	0	1	0	0	0	0	0	0	1	0	0
Fabaceae (Faboideae)	<i>Tephrosia</i> <i>phaeosperma</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Fabaceae (Faboideae)	<i>Tephrosia</i> <i>remotiflora</i>	-	0	0	1	0	0	0	0	0	0	0	0	0	0
Fabaceae (Faboideae)	<i>Tephrosia</i> sp.	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Combricaceae	<i>Terminalia</i> <i>carpentariae</i>	-	0	1	1	0	0	1	0	1	1	1	1	0	1
Poaceae	<i>Thaumatococcus</i> <i>major</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Thaumatococcus</i> <i>striata</i>	-	0	1	1	0	0	0	0	1	1	1	1	0	1
Thymelaeaceae	<i>Thecarrhena</i> <i>punicea</i>	-	0	1	0	0	0	0	0	1	0	0	0	0	0
Poaceae	<i>Themeda</i> <i>arguens</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Menispermaceae	<i>Tinospora</i> <i>smilacina</i>	-	0	0	0	0	0	0	0	0	0	0	1	0	1
Cucurbitaceae	<i>Trichosanthes</i> <i>hollieri</i>	-	1	0	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Triodia</i> <i>biflora</i>	-	0	1	0	0	0	0	0	1	0	1	1	0	0
Poaceae	<i>Triodia</i> <i>microstachya</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Malvaceae	<i>Triumfetta</i> <i>syriaca</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	0
Apocynaceae	<i>Tyrophora</i> <i>flexuosa</i>	-	0	0	0	0	0	0	0	0	0	0	1	0	0
Fabaceae (Faboideae)	<i>Uria</i> <i>lagopodioides</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0
Poaceae	<i>Urochloa</i> <i>holosericea</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	1
Poaceae	<i>Urochloa</i> <i>polyphylla</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	1



Family	Scientific Name	STATUS	Vegetation Community Number (Map Unit)														
			MU3	MU4	MU5	MU10a	MU10b	MU11	MU15a	MU16	MU17	MU18	MU20	MU24	MU31		
Fabaceae (Faboidae)	<i>Vigna lanceolata</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Fabaceae (Faboidae)	<i>Vigna sp.</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Malvaceae	<i>Waltheria indica</i>	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Whiteochloa airoides</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Poaceae	<i>Whiteochloa capillipes</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Apocynaceae	<i>Wrightia saligna</i>	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Convolvulaceae	<i>Xenostegia tridentata</i>	-	0	1	0	1	0	0	1	0	0	1	0	0	0	0	1
Xyridaceae	<i>Xyris complanata</i>	-	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Xyridaceae	<i>Xyris sp.</i>	-	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
<b>DD = Data deficient (TPWC Act)</b>			17	134	39	46	2	61	0	59	29	75	66	0	59		
<b>TOTAL number of species recorded</b>			1	13	1	2	0	2	0	2	1	6	2	0	2		
<b>N = Number of primary plots</b>			0	8	0	3	1	1	0	3	2	2	3	0	1		
<b>n= Number of secondary plots</b>																	



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*Appendix I*

# Fauna Species List

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Table I.1 Fauna Species Recorded within the Project Site

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria bicolor</i>	Northern Dwarf Tree Frog	-	-	X		
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria nasuta</i>	Rocket Frog	-	-		X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria pallida</i>	Pale Frog	-	-		X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria rothii</i>	Roth's Tree Frog	-	-	X		
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Crinia remota</i>	Remote Froglet	-	-	X	X	
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Uperoleia inundata</i>	Floodplain Toadlet	-	-	X		
AVES	APODIFORMES	AEGOTHELIDAE	<i>Aegotheles cristatus</i>	Australian Owllet-nightjar	-	-	X	X	
AVES	CAPRIMULGIFORMES	PODARGIDAE	<i>Podargus strigoides</i>	Tawny Frogmouth	-	-	X	X	
AVES	CHARADRIIFORMES	BURHINIDAE	<i>Burhinus grallarius</i>	Bush Stone-curlew	-	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Egretta novaehollandiae</i>	White-faced Heron	-	-			X
AVES	CICONIIFORMES	ARDEIDAE	<i>Nycticorax caledonicus</i>	Nankeen Night-heron	-	-			X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Chalcophaps indica</i>	Emerald Dove	-	-		X	
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Ducula bicolor</i>	Pied Imperial-pigeon	-	-		X	
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Geopelia humeralis</i>	Bar-shouldered Dove	-	-	X	X	X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Geopelia striata</i>	Peaceful Dove	-	-	X	X	X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Phaps chalcoptera</i>	Common Bronzewing	-	-	X	X	X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	-	X	X	X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Todiramphus macleayii</i>	Forest Kingfisher	-	-	X	X	
AVES	CORACIIFORMES	MEROPIIDAE	<i>Merops ornatus</i>	Rainbow Bee-eater	M(t)	-	X	X	
AVES	CUCULIFORMES	CENTROPODIDAE	<i>Centropus phasianinus</i>	Pheasant Coucal	-	-	X	X	X
AVES	CUCULIFORMES	CUCULIDAE	<i>Cacomantis variolosus</i>	Brush Cuckoo	-	-	X		
AVES	CUCULIFORMES	CUCULIDAE	<i>Eudynamys orientalis</i>	Eastern Koel	-	-		X	
AVES	CUCULIFORMES	CUCULIDAE	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	-	-		X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Accipiter fasciatus</i>	Brown Goshawk	-	-		X	X
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Aquila audax</i>	Wedge-tailed Eagle	-	-		X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Haliastur sphenurus</i>	Whistling Kite	-	-	X	X	X
AVES	GALLIFORMES	PHASIANIDAE	<i>Coturnix ypsilophora</i>	Brown Quail	-	-	X		
AVES	PASSERIFORMES	ARTAMIDAE	<i>Cracticus nigrogularis</i>	Pied Butcherbird	-	-	X	X	X
AVES	PASSERIFORMES	ARTAMIDAE	<i>Cracticus tibicen</i>	Australian Magpie	-	-	X	X	X
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	-	X	X	
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	-	-		X	
AVES	PASSERIFORMES	CORVIDAE	<i>Corvus orru</i>	Torresian Crow	-	-	X	X	X
AVES	PASSERIFORMES	DICRURIDAE	<i>Dicrurus bracteatus</i>	Spangled Drongo	-	-	X	X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
AVES	PASSERIFORMES	ESTRILDIDAE	<i>Taeniopygia bichenovii</i>	Double-barred Finch	-	-	X	X	
AVES	PASSERIFORMES	MALURIDAE	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	-	X	X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Lichmera indistincta</i>	Brown Honeyeater	-	-	X	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Melithreptus albogularis</i>	White-throated Honeyeater	-	-	X	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Myzomela obscura</i>	Dusky Honeyeater	-	-	X		
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Philemon argenticeps</i>	Silver-crowned Friarbird	-	-	X	X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Philemon citreogularis</i>	Little Friarbird	-	-		X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Stomiopera unicolor</i>	White-gaped Honeyeater	-	-	X	X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra alecto</i>	Shining Flycatcher	-	-	X		
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra rubecula</i>	Leaden Flycatcher	-	-	X	X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra ruficollis</i>	Broad-billed Flycatcher	-	-	X		
AVES	PASSERIFORMES	NECTARINIIDAE	<i>Dicaeum hirundinaceum</i>	Mistletoebird	-	-		X	
AVES	PASSERIFORMES	ORIOLIDAE	<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	-		X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	-	X	X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Colluricincla megarhyncha</i>	Little Shrike-thrush	-	-		X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Pachycephala rufiventris</i>	Rufous Whistler	-	-	X	X	
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Pachycephala simplex</i>	Grey Whistler	-	-	X		

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
AVES	PASSERIFORMES	PARDALOTIDAE	<i>Pardalotus striatus</i>	Striated Pardalote	-	-	X		
AVES	PASSERIFORMES	PETROICIDAE	<i>Microeca flavigaster</i>	Lemon-bellied Flycatcher	-	-	X		
AVES	PASSERIFORMES	POMATOSTOMIDAE	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	-		X	
AVES	PASSERIFORMES	RHIPIDURIDAE	<i>Rhipidura rufiventris</i>	Northern Fantail	-	-	X		
AVES	PSITTACIFORMES	CACATUIDAE	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	-	X		
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	-	X		
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	-	X		
AVES	STRIGIFORMES	STRIGIDAE	<i>Ninox novaeseelandiae</i>	Southern Boobook	-	-	X		
AVES	STRIGIFORMES	TYTONIDAE	<i>Tyto novaehollandiae kimberli</i>	Masked Owl (northern)	V	V	X		
AVES	TURNICIFORMES	TURNICIDAE	<i>Turnix castanotus</i>	Chestnut-backed Button-quail	-	-			X
MAMMALIA	CARNIVORA	CANIDAE	<i>Canis familiaris/lupus*</i>	Domestic Dog / Dingo	-	-		X	X
MAMMALIA	CARNIVORA	FELIDAE	<i>Felis catus*</i>	Cat	-	-			X
MAMMALIA	CHIROPTERA	EMBALLONURIDAE	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	-	X		
MAMMALIA	CHIROPTERA	EMBALLONURIDAE	<i>Taphozous georgianus</i>	Common Sheath-tail-bat	-	-	X <sup>a</sup>		
MAMMALIA	CHIROPTERA	HIPPOSIDERIDAE	<i>Hipposideros ater</i>	Dusky Leaf-nosed-bat	-	-	X		
MAMMALIA	CHIROPTERA	MOLOSSIDAE	<i>Chaerephon jobensis</i>	Northern Free-tail-bat	-	-		X <sup>a</sup>	
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Pteropus alecto</i>	Black Flying-fox	-	-			X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-		X <sup>^</sup>	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	-	-	X	X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus nigrogriseus</i> / <i>Scotorepens greyii</i>		-	-	X <sup>^</sup>	X <sup>^</sup>	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Myotis macropus</i>	Large-footed Myotis	-	-	X	X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus walkeri</i>	Pygmy Long-eared Bat	-	-	X	X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus sp.</i>		-	-		X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Vespadelus caurinus</i>	Northern Cave Bat	-	-	X	X	
MAMMALIA	DASYUROMORPHIA	DASYURIDAE	<i>Dasyurus hallucatus</i>	Northern Quoll	E	CE	X	X	X
MAMMALIA	DIPROTODONTIA	MACROPODIDAE	<i>Macropus agilis</i>	Agile Wallaby	-	-	X	X	X
MAMMALIA	DIPROTODONTIA	MACROPODIDAE	<i>Petrogale brachyotis</i>	Short-eared Rock-wallaby	-	-			X
MAMMALIA	DIPROTODONTIA	PETAURIDAE	<i>Petaurus breviceps</i>	Sugar Glider	-	-	X	X	X
MAMMALIA	MONOTREMATA	TACHYGLOSSIDAE	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	-	-			X
MAMMALIA	PERAMELEMORPHIA	PERAMELIDAE	<i>Isodon macrourus</i>	Northern Brown Bandicoot	-	-	X	X	X
MAMMALIA	RODENTIA	MURIDAE	<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	V	E			X
MAMMALIA	RODENTIA	MURIDAE	<i>Melomys burtoni</i>	Grassland Melomys	-	-	X		
MAMMALIA	RODENTIA	MURIDAE	<i>Notomys aquilo</i>	Northern Hopping-mouse	V	V		X	
MAMMALIA	RODENTIA	MURIDAE	<i>Pseudomys delicatulus</i>	Delicate Mouse	-	-	X	X	X





Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
MAMMALIA	RODENTIA	MURIDAE	<i>Zyomys argurus</i>	Common Rock-rat	-	-	X		
REPTILIA	CROCODYLIA	CROCODYLIDAE	<i>Crocodylus porosus</i>	Saltwater Crocodile	M(m)	-			X
REPTILIA	SQUAMATA	AGAMIDAE	<i>Chlamydosaurus kingii</i>	Friiled Lizard	-	-		X	
REPTILIA	SQUAMATA	AGAMIDAE	<i>Diporiphora bilineata</i>	Two-lined Dragon	-	-	X	X	
REPTILIA	SQUAMATA	AGAMIDAE	<i>Diporiphora magna</i>	Yellow-sided Two-line Dragon	-	-		X	
REPTILIA	SQUAMATA	BOIDAE	<i>Liasis olivaceus</i>	Olive Python	-	-	X		
REPTILIA	SQUAMATA	BOIDAE	<i>Morelia spilota</i>	Diamond Python	-	-	X		
REPTILIA	SQUAMATA	COLUBRIDAE	<i>Boiga irregularis</i>	Brown Tree Snake	-	-	X		
REPTILIA	SQUAMATA	ELAPIDAE	<i>Pseudonaja nuchalis</i>	Northern Brown Snake	-	-			X
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Heteronotia binoei</i>	Bynoe's Gecko	-	-	X	X	
REPTILIA	SQUAMATA	PYGOPODIDAE	<i>Delma borea</i>	Rusty-topped Delma	-	-	X	X	
REPTILIA	SQUAMATA	PYGOPODIDAE	<i>Lialis burtoni</i>	Burton's Snake-lizard	-	-			X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia amax</i>	Bauxite Rainbow-skink	-	-	X	X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia munda</i>	Shaded-litter Rainbow-skink	-	-		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia sexdentata</i>		-	-	X	X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Cryptoblepharus plagiocephalus</i>	Péron's Snake-eyed Skink	-	-		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus arnhemensis</i>	Arnhem Land Ctenotus	-	-		X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Timing		
					EPBC Act	TPWC Act	May/June 2014	October 2014	May-October 2014 (IR Cameras)
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus essingtonii</i>	Port Essington Ctenotus	-	-		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus robustus</i>	Robust Ctenotus	-	-		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	-	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Eremiascincus isolepis</i>	Northern Bar-lipped Skink	-	-	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Lerista carpentariae</i>	Carpentaria Fine-lined Slider	-	-	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia greyii</i>	Common Dwarf Skink	-	-		X	X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia maini</i>	Northern Dwarf Skink	-	-	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Notoscincus ornatus</i>	Ornate Soil-crevice Skink	-	-	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Proablepharus tenuis</i>	Northern Soil-crevice Skink	-	-		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	-	-		X	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Tiliqua scincoides intermedia</i>	Northern Blue-tongue Lizard	-	-			X
REPTILIA	SQUAMATA	TYPHLOPIDAE	<i>Ramphotyphlops minimus</i>	Groote Dwarf Blind Snake	-	-			X
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus mertensi</i>	Mertens' Water Monitor	-	V		X	X
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus panoptes</i>	Yellow-spotted Monitor	-	V		X	X
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus scalaris</i>	Spotted Tree Monitor	-	-			X

<sup>1</sup> Conservation Status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory [(m) = marine, (t) = terrestrial]

\* Denotes an exotic species

^ Call not positively identified.

Table I.2 Fauna Species Recorded During the Current and Previous Survey

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria bicolor</i>	Northern Dwarf Tree Frog	-	-	X	X	X
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria caerulea</i>	Green Tree Frog	-	-		X	X
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria microbelos</i>	Javelin Frog	-	-		X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria nasuta</i>	Rocket Frog	-	-	X	X	X
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria pallida</i>	Pale Frog	-	-	X		
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria rothii</i>	Roth's Tree Frog	-	-	X	X	X
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria rubella</i>	Desert Tree Frog	-	-		X	X
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria tornieri</i>	Tornier's Frog	-	-		X	
AMPHIBIA	ANURA	HYLIDAE	<i>Litoria watjulumensis</i>	Wojulum Frog	-	-		X	
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Crinia remota</i>	Remote Froglet	-	-	X	X	X
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Limnodynastes convexiusculus</i>	Marbled Frog	-	-		X	X
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Platyplectrum ornatum</i>	Ornate Burrowing Frog	-	-		X	X
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Uperoleia inundata</i>	Floodplain Toadlet	-	-	X	X	X
AMPHIBIA	ANURA	MYOBATRACHIDAE	<i>Uperoleia lithomoda</i>	Stonemason Toadlet	-	-		X	X
AVES	ANSERIFORMES	ANATIDAE	<i>Anas gracilis</i>	Grey Teal	-	-			X
AVES	ANSERIFORMES	ANATIDAE	<i>Anas superciliosa</i>	Pacific Black Duck	-	-		X	X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	ANSERIFORMES	ANATIDAE	<i>Dendrocygna arcuata</i>	Wandering Whistling-duck	-	-		X	
AVES	ANSERIFORMES	ANATIDAE	<i>Tadorna tadornoides</i>	Australian Shelduck	-	-		X	
AVES	APODIFORMES	AEGOTHELIDAE	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	-	-	X	X	X
AVES	APODIFORMES	APODIDAE	<i>Apus pacificus</i>	Fork-tailed Swift	M(m)	-		X	
AVES	CAPRIMULGIFORMES	CAPRIMULGIDAE	<i>Caprimulgus macrurus</i>	Large-tailed Nightjar	-	-		X	X
AVES	CAPRIMULGIFORMES	CAPRIMULGIDAE	<i>Eurostopodus argus</i>	Spotted Nightjar	-	-			X
AVES	CAPRIMULGIFORMES	PODARGIDAE	<i>Podargus strigoides</i>	Tawny Frogmouth	-	-	X	X	X
AVES	CHARADRIIFORMES	BURHINIDAE	<i>Burhinus grallarius</i>	Bush Stone-curlew	-	-	X	X	X
AVES	CHARADRIIFORMES	BURHINIDAE	<i>Esacus magnirostris</i>	Beach Stone-curlew	-	-		X	
AVES	CHARADRIIFORMES	CHARADRIIDAE	<i>Charadrius leschenaultii</i>	Greater Sand Plover	M(m)	-		X	
AVES	CHARADRIIFORMES	CHARADRIIDAE	<i>Charadrius mongolus</i>	Lesser Sand Plover	M(m)	-		X	
AVES	CHARADRIIFORMES	CHARADRIIDAE	<i>Charadrius ruficapillus</i>	Red-capped Plover	-	-		X	
AVES	CHARADRIIFORMES	CHARADRIIDAE	<i>Pluvialis fulva</i>	Pacific Golden Plover	M(m)	-			X
AVES	CHARADRIIFORMES	CHARADRIIDAE	<i>Vanellus miles</i>	Masked Lapwing	-	-		X	X
AVES	CHARADRIIFORMES	JACANIDAE	<i>Irediparra gallinacea</i>	Comb-crested Jacana	-	-		X	
AVES	CHARADRIIFORMES	LARIDAE	<i>Chroicocephalus novaehollandiae</i>	Silver Gull	-	-			X
AVES	CHARADRIIFORMES	LARIDAE	<i>Gelochelidon nilotica</i>	Gull-billed Tern	-	-			X



Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	CHARADRIIFORMES	RECURVIROSTRIDAE	<i>Himantopus himantopus</i>	Black-winged Stilt	-	-			X
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Actitis hypoleucos</i>	Common Sandpiper	M(m)	-		X	X
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	M(m)	-			X
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Calidris ferruginea</i>	Curlew Sandpiper	M(m)	V			X
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Tringa brevipes</i>	Grey-tailed Tattler	M(m)	-		X	
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Tringa nebularia</i>	Common Greenshank	M(m)	-			X
AVES	CHARADRIIFORMES	SCOLOPACIDAE	<i>Tringa stagnatilis</i>	Marsh Sandpiper	M(m)	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Ardea intermedia</i>	Intermediate Egret	-	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Ardea modesta</i>	Eastern Great Egret	M(w)	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Butorides striatus</i>	Striated Heron	-	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Egretta garzetta</i>	Little Egret	-	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Egretta novaehollandiae</i>	White-faced Heron	-	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Egretta sacra</i>	Eastern Reef Egret	M(m)	-		X	
AVES	CICONIIFORMES	ARDEIDAE	<i>Nycticorax caledonicus</i>	Nankeen Night-heron	-	-		X	
AVES	CICONIIFORMES	CICONIIDAE	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	-		X	
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Chalcophaps indica</i>	Emerald Dove	-	-		X	X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Ducula bicolor</i>	Pied Imperial-pigeon	-	-		X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Ducula spilorrhoa</i>	Torresian Imperial Pigeon	-	-			X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Geopelia humeralis</i>	Bar-shouldered Dove	-	-	X	X	X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Geopelia striata</i>	Peaceful Dove	-	-	X	X	X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Phaps chalcoptera</i>	Common Bronzewing	-	-	X	X	X
AVES	COLUMBIFORMES	COLUMBIDAE	<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove	-	-		X	X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Ceyx azureus</i>	Azure Kingfisher	-	-		X	
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Dacelo leachii</i>	Blue-winged Kookaburra	-	-	X	X	X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Todiramphus chloris</i>	Collared Kingfisher	-	-		X	
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Todiramphus macleayii</i>	Forest Kingfisher	-	-	X	X	X
AVES	CORACIIFORMES	ALCEDINIDAE	<i>Todiramphus sanctus</i>	Sacred Kingfisher	-	-		X	
AVES	CORACIIFORMES	CORACIIDAE	<i>Eurystomus orientalis</i>	Dollarbird	-	-		X	
AVES	CORACIIFORMES	MEROPIIDAE	<i>Merops ornatus</i>	Rainbow Bee-eater	M(t)	-	X	X	X
AVES	CUCULIFORMES	CENTROPODIDAE	<i>Centropus phasianinus</i>	Pheasant Coucal	-	-	X	X	
AVES	CUCULIFORMES	CUCULIDAE	<i>Cacomantis variolosus</i>	Brush Cuckoo	-	-	X	X	X
AVES	CUCULIFORMES	CUCULIDAE	<i>Chrysococcyx minutillus</i>	Little Bronze Cuckoo	-	-		X	X
AVES	CUCULIFORMES	CUCULIDAE	<i>Eudynamys orientalis</i>	Eastern Koel	-	-	X		X
AVES	CUCULIFORMES	CUCULIDAE	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo	-	-	X		



Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	-	-		X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Accipiter fasciatus</i>	Brown Goshawk	-	-	X	X	X
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Aquila audax</i>	Wedge-tailed Eagle	-	-	X	X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Aviceda subcristata</i>	Pacific Baza	-	-			X
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Circus assimilis</i>	Spotted Harrier	-	-		X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	-	-		X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Haliastur indus</i>	Brahminy Kite	-	-		X	
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Haliastur sphenurus</i>	Whistling Kite	-	-	X	X	X
AVES	FALCONIFORMES	ACCIPITRIDAE	<i>Pandion cristatus</i>	Eastern Osprey	M(m)	-		X	
AVES	FALCONIFORMES	FALCONIDAE	<i>Falco berigora</i>	Brown Falcon	-	-		X	X
AVES	GALLIFORMES	MEGAPODIIDAE	<i>Megapodius reinwardt</i>	Orange-footed Scrubfowl	-	-		X	X
AVES	GALLIFORMES	PHASIANIDAE	<i>Coturnix ypsilophora</i>	Brown Quail	-	-	X	X	
AVES	GALLIFORMES	PHASIANIDAE	<i>Excalfactoria chinensis</i>	King Quail	-	-		X	
AVES	GRUIFORMES	GRUIDAE	<i>Grus rubicunda</i>	Brolga	-	-		X	
AVES	GRUIFORMES	RALLIDAE	<i>Eulabeornis castaneiventris</i>	Chestnut Rail	-	-		X	
AVES	PASSERIFORMES	ACANTHIZIDAE	<i>Gerygone chloronota</i>	Green-backed Gerygone	-	-		X	X
AVES	PASSERIFORMES	ACANTHIZIDAE	<i>Gerygone levigaster</i>	Mangrove Gerygone	-	-		X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	PASSERIFORMES	ACANTHIZIDAE	<i>Gerygone magnirostris</i>	Large-billed Gerygone	-	-		X	X
AVES	PASSERIFORMES	ARTAMIDAE	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	-	-		X	X
AVES	PASSERIFORMES	ARTAMIDAE	<i>Artamus minor</i>	Little Woodswallow	-	-		X	X
AVES	PASSERIFORMES	ARTAMIDAE	<i>Cracticus nigrogularis</i>	Pied Butcherbird	-	-	X	X	X
AVES	PASSERIFORMES	ARTAMIDAE	<i>Cracticus tibicen</i>	Australian Magpie	-	-	X	X	X
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	-	X	X	X
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	-	-	X	X	X
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Coracina tenuirostris</i>	Cicadabird	-	-		X	X
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Lalage leucomela</i>	Varied Triller	-	-		X	X
AVES	PASSERIFORMES	CAMPEPHAGIDAE	<i>Lalage sueurii</i>	White-winged Triller	-	-		X	
AVES	PASSERIFORMES	CISTICOLIDAE	<i>Cisticola exilis</i>	Golden-headed Cisticola	-	-		X	
AVES	PASSERIFORMES	CORVIDAE	<i>Corvus orru</i>	Torresian Crow	-	-	X	X	X
AVES	PASSERIFORMES	DICRURIDAE	<i>Dicrurus bracteatus</i>	Spangled Drongo	-	-	X	X	X
AVES	PASSERIFORMES	ESTRILDIDAE	<i>Taeniopygia bichenovii</i>	Double-barred Finch	-	-	X	X	X
AVES	PASSERIFORMES	HIRUNDINIDAE	<i>Petrochelidon nigricans</i>	Tree Martin	-	-		X	
AVES	PASSERIFORMES	MALURIDAE	<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	-	-	X	X	X
AVES	PASSERIFORMES	MEGALURIDAE	<i>Megalurus timoriensis</i>	Tawny Grassbird	-	-		X	



Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Conopophila albogularis</i>	Rufous-banded Honeyeater	-	-		X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Lichmera indistincta</i>	Brown Honeyeater	-	-	X	X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Meliphreptus albogularis</i>	White-throated Honeyeater	-	-	X	X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Myzomela erythrocephala</i>	Red-headed Honeyeater	-	-		X	
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Myzomela obscura</i>	Dusky Honeyeater	-	-	X		
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Philemon argenticeps</i>	Silver-crowned Friarbird	-	-	X	X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Philemon citreogularis</i>	Little Friarbird	-	-	X	X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Ramsayornis fasciatus</i>	Bar-breasted Honeyeater	-	-		X	X
AVES	PASSERIFORMES	MELIPHAGIDAE	<i>Stomiopera unicolor</i>	White-gaped Honeyeater	-	-	X	X	X
AVES	PASSERIFORMES	MONARCHIDAE	<i>Grallina cyanoleuca</i>	Magpie-lark	-	-			X
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra alecto</i>	Shining Flycatcher	-	-	X	X	X
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra inquieta</i>	Restless Flycatcher	-	-		X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra rubecula</i>	Leaden Flycatcher	-	-	X	X	X
AVES	PASSERIFORMES	MONARCHIDAE	<i>Myiagra ruficollis</i>	Broad-billed Flycatcher	-	-	X	X	
AVES	PASSERIFORMES	MONARCHIDAE	<i>Symphysistichus trivirgatus</i>	Spectacled Monarch	M(m)	-			X
AVES	PASSERIFORMES	MOTACILLIDAE	<i>Anthus novaeseelandiae</i>	Australasian Pipit	-	-			X
AVES	PASSERIFORMES	NECTARINIIDAE	<i>Dicaeum hirundinaceum</i>	Misttitebird	-	-	X	X	X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	PASSERIFORMES	ORIOLIDAE	<i>Oriolus flavocinctus</i>	Yellow Oriole	-	-		X	X
AVES	PASSERIFORMES	ORIOLIDAE	<i>Oriolus sagittatus</i>	Olive-backed Oriole	-	-	X	X	X
AVES	PASSERIFORMES	ORIOLIDAE	<i>Sphecotheres vieilloti</i>	Australasian Figbird	-	-		X	X
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	-	X	X	X
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Colluricincla megarrhyncha</i>	Little Shrike-thrush	-	-	X		X
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Pachycephala rufiventris</i>	Rufous Whistler	-	-	X	X	X
AVES	PASSERIFORMES	PACHYCEPHALIDAE	<i>Pachycephala simplex</i>	Grey Whistler	-	-	X	X	X
AVES	PASSERIFORMES	PARDALOTIDAE	<i>Pardalotus striatus</i>	Striated Pardalote	-	-	X	X	X
AVES	PASSERIFORMES	PETROICIDAE	<i>Microeca flavigaster</i>	Lemon-bellied Flycatcher	-	-	X	X	X
AVES	PASSERIFORMES	PITTIDAE	<i>Pitta iris</i>	Rainbow Pitta	-	-		X	X
AVES	PASSERIFORMES	POMATOSTOMIDAE	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	-	X	X	X
AVES	PASSERIFORMES	PTILONORHYNCHIDAE	<i>Ptilonorhynchus nuchalis</i>	Great Bowerbird	-	-		X	X
AVES	PASSERIFORMES	RHIPIDURIDAE	<i>Rhipidura dryas</i>	Arafura Fantail	-	-		X	
AVES	PASSERIFORMES	RHIPIDURIDAE	<i>Rhipidura rufifrons</i>	Rufous Fantail	-	-			X
AVES	PASSERIFORMES	RHIPIDURIDAE	<i>Rhipidura rufiventris</i>	Northern Fantail	-	-	X	X	X
AVES	PASSERIFORMES	TIMALIIDAE	<i>Zosterops luteus</i>	Yellow White-eye	-	-		X	X
AVES	PELECANIFORMES	ANHINGIDAE	<i>Anhinga novaehollandiae</i>	Australasian Darter	-	-		X	

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
AVES	PELECANIFORMES	PHALACROCORACIDAE	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	-	-			X
AVES	PODICIPEDIFORMES	PODICIPEDIDAE	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	-	-		X	X
AVES	PSITTACIFORMES	CACATUIDAE	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	-	X	X	X
AVES	PSITTACIFORMES	CACATUIDAE	<i>Cacatua sanguinea</i>	Little Corella	-	-		X	X
AVES	PSITTACIFORMES	CACATUIDAE	<i>Calyptorhynchus banksii</i>	Red-tailed Black-cockatoo	-	-			X
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Aprosmictus erythropterus</i>	Red-winged Parrot	-	-	X	X	X
AVES	PSITTACIFORMES	PSITTACIDAE	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	-	X	X	X
AVES	STRIGIFORMES	STRIGIDAE	<i>Ninox novaeseelandiae</i>	Southern Boobook	-	-	X	X	X
AVES	STRIGIFORMES	TYTONIDAE	<i>Tyto novaehollandiae kimberli</i>	Masked Owl (northern)	V	V	X	X	
AVES	TURNICIFORMES	TURNICIDAE	<i>Turnix castanotus</i>	Chestnut-backed Button-quail	-	-	X	X	X
MAMMALIA	CARNIVORA	CANIDAE	<i>Canis familiaris</i> *	Domestic Dog	-	-		X	X
MAMMALIA	CARNIVORA	CANIDAE	<i>Canis familiaris/lupus</i> *	Domestic Dog / Dingo	-	-	X	X	
MAMMALIA	CARNIVORA	CANIDAE	<i>Canis lupus</i>	Dingo	-	-			X
MAMMALIA	CARNIVORA	FELIDAE	<i>Felis catus</i> *	Cat	-	-	X	X	X
MAMMALIA	CHIROPTERA	EMBALLONURIDAE	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	-	X	X	
MAMMALIA	CHIROPTERA	EMBALLONURIDAE	<i>Taphozous georgianus</i>	Common Sheath-tail-bat	-	-	X	X	
MAMMALIA	CHIROPTERA	HIPPOSIDERIDAE	<i>Hipposideros ater</i>	Dusky Leaf-nosed-bat	-	-	X		

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
MAMMALIA	CHIROPTERA	MEGADERMATIDAE	<i>Macroderma gigas</i>	Ghost Bat	-	-		X	
MAMMALIA	CHIROPTERA	MOLOSSIDAE	<i>Chaerephon jobensis</i>	Northern Freetail-bat	-	-	X <sup>^</sup>		
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Macroglossus minimus</i>	Northern Blossom-bat	-	-		X	
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Pteropus alecto</i>	Black Flying-fox	-	-	X	X	
MAMMALIA	CHIROPTERA	PTEROPODIDAE	<i>Pteropus scapulatus</i>	Little Red Flying-fox	-	-		X	X
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-	X <sup>^</sup>		
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	-	-	X	X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Chalinolobus nigrogriseus</i> / <i>Scotorepens greyii</i>		-	-	X <sup>^</sup>		
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Myotis macropus</i>	Large-footed Myotis	-	-	X	X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus arnhemensis</i>	Arnhem Long-eared Bat	-	-		X	
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus walkeri</i>	Pygmy Long-eared Bat	-	-	X		
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Nyctophilus sp.</i>		-	-	X		
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Vespdelus caurinus</i>	Northern Cave Bat	-	-	X	X	X
MAMMALIA	CHIROPTERA	VESPERTILIONIDAE	<i>Vespdelus finlaysoni</i>	Finlayson's Cave Bat	-	-		X	
MAMMALIA	DASYUROMORPHIA	DASYURIDAE	<i>Dasyurus hallucatus</i>	Northern Quoll	E	CE	X	X	X
MAMMALIA	DASYUROMORPHIA	DASYURIDAE	<i>Planigale maculata</i>	Common Planigale	-	-		X	X
MAMMALIA	DIPROTODONTIA	MACROPODIDAE	<i>Macropus agilis</i>	Agile Wallaby	-	-	X	X	X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)
MAMMALIA	DIPROTODONTIA	MACROPODIDAE	<i>Petrogale brachyotis</i>	Short-eared Rock-wallaby	-	-	X		X
MAMMALIA	DIPROTODONTIA	PETAURIDAE	<i>Petaurus breviceps</i>	Sugar Glider	-	-	X	X	X
MAMMALIA	DIPROTODONTIA	PHALANGERIDAE	<i>Trichosurus vulpecula arnhemensis</i>	Common Brushtail Possum (northern)	-	-		X	
MAMMALIA	DIPROTODONTIA	PSEUDOCHEIRIDAE	<i>Petropseudes dahli</i>	Rock Ringtail Possum	-	-			X
MAMMALIA	MONOTREMATA	TACHYGLOSSIDAE	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	-	-	X	X	X
MAMMALIA	PERAMELEMORPHIA	PERAMELIDAE	<i>Isodon macrourus</i>	Northern Brown Bandicoot	-	-	X	X	X
MAMMALIA	RODENTIA	MURIDAE	<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-rat	V	E	X		
MAMMALIA	RODENTIA	MURIDAE	<i>Hydromys chrysogaster</i>	Water-rat	-	-		X	
MAMMALIA	RODENTIA	MURIDAE	<i>Melomys burtoni</i>	Grassland Melomys	-	-	X	X	X
MAMMALIA	RODENTIA	MURIDAE	<i>Notomys aquilo</i>	Northern Hopping-mouse	V	V	X		
MAMMALIA	RODENTIA	MURIDAE	<i>Pseudomys delicatulus</i>	Delicate Mouse	-	-	X	X	X
MAMMALIA	RODENTIA	MURIDAE	<i>Zyzomys argurus</i>	Common Rock-rat	-	-	X		X
REPTILIA	CROCODYLIA	CROCODYLIDAE	<i>Crocodylus porosus</i>	Saltwater Crocodile	M(m)	-	X	X	X
REPTILIA	SQUAMATA	AGAMIDAE	<i>Chlamydosaurus kingii</i>	Fringed Lizard	-	-	X	X	X
REPTILIA	SQUAMATA	AGAMIDAE	<i>Diporiphora bilineata</i>	Two-lined Dragon	-	-	X	X	X
REPTILIA	SQUAMATA	AGAMIDAE	<i>Diporiphora magna</i>	Yellow-sided Two-line Dragon	-	-	X		
REPTILIA	SQUAMATA	AGAMIDAE	<i>Lophognathus gilberti</i>	Gilbert's Dragon	-	-		X	X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)	
REPTILIA	SQUAMATA	BOIDAE	<i>Antaresia childreani</i>	Children's Python	-	-		X		X
REPTILIA	SQUAMATA	BOIDAE	<i>Liasis fuscus</i>	Water Python	-	-		X		X
REPTILIA	SQUAMATA	BOIDAE	<i>Liasis olivaceus</i>	Olive Python	-	-	X			X
REPTILIA	SQUAMATA	BOIDAE	<i>Morelia spilota</i>	Diamond Python	-	-	X			
REPTILIA	SQUAMATA	COLUBRIDAE	<i>Boiga irregularis</i>	Brown Tree Snake	-	-	X	X		X
REPTILIA	SQUAMATA	COLUBRIDAE	<i>Dendrelaphis punctulatus</i>	Common Tree Snake	-	-		X		
REPTILIA	SQUAMATA	COLUBRIDAE	<i>Tropidonophis mairii</i>	Freshwater Snake	-	-		X		X
REPTILIA	SQUAMATA	DIPLODACTYLIDAE	<i>Amalosa rhombifer</i>	Zigzag Velvet Gecko	-	-		X		X
REPTILIA	SQUAMATA	DIPLODACTYLIDAE	<i>Oedura marmorata</i>	Marbled Velvet Gecko	-	-				X
REPTILIA	SQUAMATA	ELAPIDAE	<i>Acanthophis praelongus</i>	Northern Death Adder	-	-		X		
REPTILIA	SQUAMATA	ELAPIDAE	<i>Pseudechis australis</i>	King Brown Snake	-	-				X
REPTILIA	SQUAMATA	ELAPIDAE	<i>Pseudechis weigeli</i>	Weigel's Black Snake	-	-		X		
REPTILIA	SQUAMATA	ELAPIDAE	<i>Pseudonaja nuchalis</i>	Northern Brown Snake	-	-	X	X		
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Gehyra australis</i>	Northern Dtella	-	-		X		X
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Gehyra pamela</i>	Arnhemland Watercourse Dtella	-	-				X
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Hemidactylus frenatus</i>	Asian Gecko	-	-		X		
REPTILIA	SQUAMATA	GEKKONIDAE	<i>Heteronotia binoei</i>	Bynoe's Gecko	-	-	X	X		X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>			Survey Records		
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)	
REPTILIA	SQUAMATA	HOMALOPSIDAE	<i>Enhydryis polylepis</i>	Macleay's Water Snake	-	-		X		X
REPTILIA	SQUAMATA	PYGOPODIDAE	<i>Delma borea</i>	Rusty-topped Delma	-	-	X	X		X
REPTILIA	SQUAMATA	PYGOPODIDAE	<i>Lialis burtoni</i>	Burton's Snake-lizard	-	-	X	X		X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia amax</i>	Bauxite Rainbow-skink	-	-	X	X		X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia longipes</i>	Closed-litter Rainbow-skink	-	-				X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia munda</i>	Shaded-litter Rainbow-skink	-	-	X	X		X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Carlia sexdentata</i>		-	-	X	X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Cryptoblepharus metallicus</i>	Metallic Snake-eyed Skink	-	-		X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Cryptoblepharus plagiocephalus</i>	Péron's Snake-eyed Skink	-	-	X			X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus arnhemensis</i>	Arnhem Land Ctenotus	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus essingtonii</i>	Port Essington Ctenotus	-	-	X			X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus inornatus</i>	Bar-shouldered Ctenotus	-	-		X		X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus quirinus</i>		-	-		X		
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus robustus</i>	Robust Ctenotus	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Ctenotus spaldingi</i>	Spalding's Ctenotus	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Eremiascincus isolepis</i>	Northern Bar-lipped Skink	-	-	X			X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Glaphyromorphus nigricaudis</i>	Black-tailed Bar-lipped Skink	-	-		X		X

Class	Order	Family	Scientific Name	Common Name	Conservation Status <sup>1</sup>		Survey Records			
					EPBC Act	TPWC Act	Cumberland Ecology (2014)	URS (2012)	Webb (1992)	
REPTILIA	SQUAMATA	SCINCIDAE	<i>Lerista carpentariae</i>	Carpentaria Fine-lined Slider	-	-	X	X	X	X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia alanae</i>	Alana's Menetia	-	-		X	X	X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia greyii</i>	Common Dwarf Skink	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Menetia maini</i>	Northern Dwarf Skink	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Notoscincus ornatus</i>	Ornate Soil-crevice Skink	-	-	X	X	X	X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Proablepharus tenuis</i>	Northern Soil-crevice Skink	-	-	X	X	X	X
REPTILIA	SQUAMATA	SCINCIDAE	<i>Tiliqua scincoides</i>	Eastern Blue-tongue	-	-	X			
REPTILIA	SQUAMATA	SCINCIDAE	<i>Tiliqua scincoides intermedia</i>	Northern Blue-tongue Lizard	-	-	X	X	X	X
REPTILIA	SQUAMATA	TYPHLOPIDAE	<i>Ramphotyphlops minimus</i>	Groote Dwarf Blind Snake	-	-	X			
REPTILIA	SQUAMATA	TYPHLOPIDAE	<i>Ramphotyphlops unguirostris</i>	Claw-snouted Blind Snake	-	-				X
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus glebopalma</i>	Black-palmed Monitor	-	-			X	X
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus mertensi</i>	Mertens' Water Monitor	-	V	X	X	X	X
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus panoptes</i>	Yellow-spotted Monitor	-	V	X	X	X	
REPTILIA	SQUAMATA	VARANIDAE	<i>Varanus scalaris</i>	Spotted Tree Monitor	-	-	X	X	X	X

<sup>1</sup> Conservation Status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory [(m) = marine, (t) = terrestrial, (w) = wetland]

\* Denotes an exotic species

^ Call not positively identified.





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*Appendix J*

# Assessments of Significance

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## J.1 Introduction

Assessments of Significance (AOS) are typically threshold tests of significance prepared according to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013r). AOS provide a means by which to gauge the significance of predicted impacts to MNES, such as threatened species and ecological communities. They are designed specifically to determine whether a project should be referred to DotE, and to identify which MNES may be impacted by a project. Therefore, at the referral stage, the AOS are high level, and do not specifically consider individual species, and nor do they consider or apply any mitigation or management measures that will be implemented for the project.

AOS were prepared in 2013 for the referral of this project to DotE. Based upon the information available at the time of the referral, the project was declared a Controlled Action by DotE, as it was deemed likely to have a significant impact on threatened species and ecological communities, and on migratory species.

Following the detailed environmental studies that were undertaken for this EIS, it is now possible to utilise the AOS process to theoretically quantify the impacts of the project on the specific MNES species that were found within the project site, or that were considered to have a high to moderate potential of occurring within the project site. This will enable a more accurate assessment of the significance of the project's impacts on MNES, and consequently will help inform discussions regarding offsets for specific species.



## J.2 Assessments of Significance

AOS are provided below for each of the MNES species found to occur, or with a high to moderate potential to occur, within the project site (listed in **Table J.1**). The AOS consider the environmental impacts and mitigation that have been generated by the EIS work. Further details on the habitat requirements and occurrence of these species within the project site are provided within the main body of this report.

**Table J.1 MNES Recorded Within the Project Site or Potentially Present**

Common Name	Scientific Name	EPBC Act Status <sup>1</sup>	Likelihood of Occurrence	Section Reference
<b>Birds</b>				
Masked Owl (northern)	<i>Tyto novaehollandiae kimberli</i>	V	Present	J.3
Rainbow Bee-eater	<i>Merops ornatus</i>	M(t)	Present	J.7
Fork-tailed Swift	<i>Apus pacificus</i>	M(m)	Moderate	J.7
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	M(t)	Moderate	J.7
Rufous Fantail	<i>Rhipidura rufifrons</i>	M(t)	Moderate	J.7
<b>Mammals</b>				
Brush-tailed Rabbit-rat	<i>Conilurus penicillatus</i>	V	Present	J.4
Northern Quoll	<i>Dasyurus hallucatus</i>	E	Present	J.5
Northern Hopping-mouse	<i>Notomys aquilo</i>	V	Present	J.6
<b>Reptiles</b>				
Salt-water Crocodile	<i>Crocodylus porosus</i>	M(m)	Present	J.7

<sup>1</sup> Conservation Status: V = Vulnerable, E = Endangered, M = Migratory [(m) = marine, (t) = terrestrial, (w) = wetland]



### J.3 Masked Owl (northern)

**Scientific Name:** *Tyto novaehollandiae kimberli*

**EPBC Act Status:** Vulnerable

According to the Significant Impact Guidelines (DotE, 2013r), the concept of an 'important population' is central to assessing the potential for an action to have a significant impact on a Vulnerable species. An important population is defined as '*a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:*

- *key source populations either for breeding or dispersal*
- *populations that are necessary for maintaining genetic diversity, and/or*
- *populations that are near the limit of the species range.'*

Each of these points is addressed below.

- *Key source population either for breeding or dispersal*

The individuals of the Masked Owl (northern) that were observed in and near the project site in 2014 are part of a recently detected population that occurs on Groote Eylandt. Data on occurrences of the species across the island is quite limited. Previously there have been only four records of Masked Owl (northern) on Groote Eylandt. These were recorded near to the existing GEMCO mine (URS Australia Pty Ltd, 2012), and therefore outside of the Eastern Leases project site. The study by URS (2012) detected the species at 10% (four out of 40 sites) of survey locations. The low number of records for the species is likely to be an artefact of the low number of owl surveys completed on the island in the past, rather than reflecting the rarity of the owl on Groote Eylandt. The majority of potential habitat on the island has not been surveyed.

Habitat for the owl includes open forest and woodland, which is widespread and contiguous on the island, though surveys for owls have been largely restricted to the mineral lease areas on the western side of the island. It is estimated that there is 118,071 ha of open forest and 55,196 ha of sandstone woodland on the island. The owl is also expected to forage in other habitats such as riparian areas and coastal dune complexes, but for the purposes of this assessment, only forest and woodland habitats will be considered. Therefore, the suitable habitats for the species on the island include at least 173,267 ha of land.

The Masked Owl (northern) is sedentary and territorial. Little is known of the home ranges of the northern subspecies, however individual home ranges of the southern form of the species are known to vary between 150 ha and 1,200 ha in breeding and non-breeding seasons respectively. Individual owls detected the



Northern EL and Southern EL would likely disperse across home ranges that include areas adjacent to the project site.

The sex and breeding status of individuals observed within the project site are unknown, but for the purposes of this assessment it is assumed that they represent one to several breeding pairs of birds.

Although the Masked Owl (northern) occurs widely across Northern Australia, with the limited data available, it is assumed that the owls on Groote Eylandt as a whole, constitute a distinct and important population. The individuals that occur within the project site are considered to comprise a subset, or small part of the Groote Eylandt population, which for the purposes of this assessment is considered to be a key source population.

➤ *Populations that are necessary for maintaining genetic diversity*

Groote Eylandt is a large island with relatively pristine vegetation and intact assemblages of native flora and fauna. The owl population on the island has not been studied in detail, but, given an approximate home range of 1,200 ha in the non-breeding season, and at least 173,267 ha of available habitat on the island, a conservative minimum population estimation for the island is 150 individuals.

It is unclear if and to what extent the species travels between Groote Eylandt, and other islands and the mainland.

Island populations of fauna are often genetically distinct. For the purposes of this assessment it is assumed that the island population could represent a distinct form of the species and so be important for maintaining genetic diversity.

➤ *Populations that are near the limit of the species range*

The project site is not located near the limit of the range of the Masked Owl (northern). It occurs across the top end of the Northern Territory, Queensland and Western Australia.

For the reasons outlined above, the population of the Masked Owl (northern) that occurs in the project site is considered to comprise an 'important population' as defined by the EPBC Act.

### **Significant Impact Criteria**

The Significant Impact Guidelines also define a number of criteria to determine if an action is likely to have a significant impact on a species listed as Vulnerable under the EPBC Act. Each of these criteria are addressed below.

*An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of an important population of a species;*



The project will reduce the area of occupancy of this species by removing 1,525 ha of forest and woodland comprising 1,119 ha of open forests, 6 ha of sandstone woodland and rock outcrop, 290 ha of woodland/shrubland and 5 ha of riparian habitat known to be occupied by the owl. This constitutes 0.8% of the open forest and woodland on the island. Even if the mine area was left unrehabilitated, it is likely that the majority of habitable area on the island would remain. However, the project site will be rehabilitated to open forest and woodland and so in the long term the project is unlikely to lead to a long-term decrease in the size of an important population of the species.

➤ *reduce the area of occupancy of an important population;*

The project will clear 1,525 ha of open forest and woodland and, in the absence of rehabilitation, would slightly reduce the area of occupancy of an important population (0.8%). However, the project site will be rehabilitated and so in the long term it is unlikely to reduce the area of occupancy of the population. GEMCO has successfully rehabilitated mined areas as open woodland and these rehabilitated areas could be expected to provide foraging habitat for this species.

➤ *fragment an existing important population into two or more populations;*

The project site is surrounded by similar vegetation to that which will be removed and impacted. Retained vegetation within the project site will remain contiguous with the surrounding habitats.

➤ *adversely affect habitat critical to the survival of a species;*

The habitat to be removed in the project site includes 1,119 ha of open forest, 6 ha of sandstone woodland and 5 ha of riparian habitat containing old growth forests that contains tree hollows used for breeding. Tree hollows are critical for survival of owls, but the area to be removed constitutes 0.8% of the open forest on the island and so the habitat clearance is unlikely to threaten the survival of the species as a whole.

➤ *disrupt the breeding cycle of an important population;*

As stated above, trees will be removed that may contain hollows suitable for breeding, and it is possible that some breeding pairs could have breeding disrupted in the long term by the progressive clearance of habitat. Large areas of similar habitat, including suitable breeding habitat, will remain in the locality that will continue to provide habitat for this species.

➤ *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*

The Masked Owl (northern) population of Groote Eylandt is unlikely to decline as a result of habitat removed for the project. Large areas of similar habitat occur in the locality that will remain, and this species will remain viable in these areas.



- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;*

It is considered unlikely that the project will result in an invasive species becoming established in habitat for the Masked Owl (northern). Few feral animals occur on Groote Eylandt and these are strictly managed. It is unlikely that any invasive plant or animal will become established as a result of the project.

- *introduce disease that may cause the species to decline, or*

It is considered unlikely that the project will introduce a disease that may cause the Masked Owl (northern) to decline. Disease is not known to be a threat to this species.

- *interfere substantially with the recovery of the species.*

The project will interfere to some degree with the recovery of the Masked Owl (northern). The project will result in the removal of areas of breeding and foraging habitat for this species, and will result in a reduction in the area of habitat available to this species. However, large areas of similar habitat occur in the locality that will remain, and this species will remain viable in these areas. Furthermore, mined areas will be rehabilitated to contain woodland habitats that will provide suitable habitat for this species in the long term.

## Conclusion

Taking a precautionary approach, it is assumed that the occurrence of the Masked Owl (northern) on Groote Eylandt is an important population. The project will result in the removal of 1,525 ha of breeding and foraging habitat for the Masked Owl (northern) amounting to 0.8% of the available habitat on the island. Even if the mine site was not rehabilitated, extensive habitat would remain for the owl on the island. However, rehabilitation is proposed and forest and woodland will be restored on the mine site in the long term.

The project will not cause the introduction of invasive species to the island, and will not increase the risk of disease or interfere with the recovery of the species.

Accordingly, no significant impact is predicted to occur to the Masked Owl (northern) as result of the project.



## J.4 Brush-tailed Rabbit-rat

**Scientific Name:** *Conilurus penicillatus*

**EPBC Act Status:** Vulnerable

According to the Significant Impact Guidelines (DotE, 2013r), the concept of an 'important population' is central to assessing the potential for an action to have a significant impact on a Vulnerable species. An important population is defined as '*a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:*

- *key source populations either for breeding or dispersal*
- *populations that are necessary for maintaining genetic diversity, and/or*
- *populations that are near the limit of the species range.'*

Each of these points is addressed below.

- *Key source population either for breeding or dispersal*

Data on the Brush-tailed Rabbit-rat on Groote Eylandt is limited (Woinarski and Hill, 2012a), and it is unclear whether one or more populations exist on the island. Only a small number of records for the species exist (Woinarski and Hill, 2012a), with only two sightings from the project site, and less than ten records across Groote Eylandt. Field surveys indicated that not all potential habitat within the project site for this species is necessarily utilised, and it seems likely that the population of the Brush-tailed Rabbit-rat on Groote Eylandt may exist as a series of scattered subpopulations.

Despite the lack of records, the population on Groote Eylandt should be considered to potentially be a key source population as it is an island population that is separate from the declining populations on the mainland.

- *Populations that are necessary for maintaining genetic diversity*

The status of the Brush-tailed Rabbit Rat is uncertain. The species has declined substantially in the past 10 years on the Australian mainland, as well as within island communities, and the causes for this decline are unclear (Woinarski and Hill, 2012a).

Offshore islands can be important to the overall genetic diversity of a species because the species is typically protected from some of the threats experienced on the mainland (NRETAS, 2009).

Therefore, it is assumed for this assessment, that the population of the Brush-tailed Rabbit-rat on Groote Eylandt may be important to the species for the maintenance of genetic diversity.





➤ *Populations that are near the limit of the species range*

The species is thought to occur across the wet tropics of the NT, including islands off the coast of the mainland, such as Groote Eylandt and the Tiwi Islands (Woinarski and Hill, 2012a). The population of the Brush-tailed Rabbit-rat on Groote Eylandt, is considered to be toward its northern geographic limits.

For the reasons outlined above, the population of the Brush-tailed Rabbit-rat that occurs in the project site is considered to comprise an 'important population' as defined by the EPBC Act.

### **Significant Impact Criteria**

The Significant Impact Guidelines also define a number of criteria to determine if an action is likely to have a significant impact on a species listed as Vulnerable under the EPBC Act. Each of these criteria are addressed below.

*An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

➤ *lead to a long-term decrease in the size of an important population of a species*

The project will remove 1,525 ha of habitat that is potentially suitable for the species. Although the area to be cleared represents approximately 0.8% of the potential habitat for this species on the island, it is unclear what proportion of the existing population will be impacted.

It is also unknown whether the Brush-tailed Rabbit-rat can colonise mine rehabilitation. No individuals of Brush-tailed Rabbit-rat were observed during field surveys of mine rehabilitation that were undertaken for the project. It is noted, however, that this species is difficult to record during field surveys and there are very few records of this species in undisturbed areas of Groote Eylandt.

Given the causes for decline of the species are not understood (Woinarski and Hill, 2012a) and that population size is unknown, the removal of verified habitat within the project site could lead to a long-term decrease in the size of an important population of this species.

➤ *reduce the area of occupancy of an important population*

The project will clear approximately 1,525 ha, or 0.8% of the potential habitat for this species on the island. This species is known to have a very limited home range of approximately 1 ha, and given there is limited information regarding the distribution of the species on the island, it is assumed, for the purposes of this assessment, that the project is likely to reduce the area of occupancy of populations of this species within the project site.

For this reason it is conceivable that the project has potential to reduce the area of occupancy of an important population of the species.



- *fragment an existing important population into two or more populations*

The project will result in the clearing of an estimated 0.6% of the potential habitat for this species on the island. This species is known to have a very limited home range of approximately 1 ha, and given there is limited information regarding the distribution of the species on the island, it is assumed, for the purposes of this assessment, that the project may fragment an existing population into two or more populations.

- *adversely affect habitat critical to the survival of a species*

No critical habitat has been identified for the species on the project site.

- *disrupt the breeding cycle of an important population*

As the proposed mining would clear approximately 0.6% of potential habitat on the island, based on the amount of habitat remaining, it would seem unlikely that the breeding cycle of the species will be significantly disrupted across the island. However, as the causes for declines of the species are not understood (Woinarski and Hill, 2012a) and that population size on the island is unknown, disruption of the breeding cycle cannot entirely be ruled out.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The project will result in the removal of 1,130 ha or 0.6% of the potential habitat available for this species on the island. The Brush-tailed Rabbit-rat has declined across its NT range by more than 50% in the past decade, including in other relatively undisturbed areas such as Kakadu National Park, although the cause for this decline is unknown (Woinarski and Hill, 2012a).

This species has not been observed within the rehabilitated areas of the existing GEMCO mine, and it is therefore unknown if this species would colonise rehabilitated woodlands. Assuming the species does not inhabit these areas, it is likely that the project will modify and potentially destroy available habitat to the extent that it may impact species numbers, and contribute to the local population to declining.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

An as yet unconfirmed theory about mammal species declining in northern Australia is that they may fail to compete with introduced mammals such as the Black Rat (Fitzsimons *et al.*, 2010). It is conceivable that invasive species such as the Black Rat could establish near the project site in the future, and may compete with the Brush-tailed Rabbit-rat for food and shelter resources within the project site. Feral animal control measures are proposed for the project site which would assist in mitigating this impact.



- *introduce disease that may cause the species to decline, or*

An as yet unconfirmed theory about mammal species declining in northern Australia is that a disease or diseases may have been introduced with invasive mammals such as the Black Rat (Fitzsimons *et al.*, 2010). It is conceivable that such species could establish near the project site in the future, and could spread disease harmful to Brush-tailed Rabbit-rat (Fitzsimons *et al.*, 2010).

Feral animal control measures are proposed for the project site which would assist in mitigating this impact.

- *interfere substantially with the recovery of the species.*

Given the uncertainty that exists about the species decline in Australia (Woinarski and Hill, 2012a), and the potential importance of the island population, it is unclear if, and to what extent, the project may interfere with the recovery of the species.

## **Conclusion**

Taking a precautionary approach, it is assumed that the occurrence of the Brush-tailed Rabbit-rat on Groote Eylandt is an important population. The project will result in the removal of 1,130 ha of potential habitat for this species, amounting to 0.6% of the available habitat on the island. However, it is unclear how much of this habitat is occupied by this species on the island (Woinarski and Hill, 2012a).

Across its range, the Brush-tailed Rabbit-rat has declined substantially during the past decade and causes for the decline are unclear (Fitzsimons *et al.*, 2010; Woinarski and Hill, 2012a).

The project has potential to result in the loss of habitat for the species, and there is no evidence that the species has, or will, recolonise within rehabilitated mine areas. Indirect impacts of mining could also include competition and the spread of disease from invasive species such as rodents.

As such, the project could potentially result in a significant impact on this species. Offsets will be provided for this impact, as discussed in the EIS Biodiversity Offsets Strategy.



## J.5 Northern Quoll

**Scientific Name:** *Dasyurus hallucatus*

**EPBC Act Status:** Endangered

The Northern Quoll occurs on the project site and is widespread across Groote Eylandt.

According to the Significant Impact Guidelines (DotE, 2013r), all occurrences of Endangered species are taken to represent important “populations”. The Groote Eylandt population is also one of the few remaining populations in Australia that appears to be thriving, as it is not impacted by the Cane Toad, which is a key threat to the Quoll on the mainland. As such, the population of Northern Quoll on Groote Eylandt is considered to have high conservation significance (NRETAS, 2009).

### Significant Impact Criteria

The Significant Impact Guidelines provide a number of criteria to determine if an action is likely to have a significant impact on a species listed as Endangered under the EPBC Act. Each of these criteria are addressed below.

*An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of a population*

Extensive information exists about the status of the Northern Quoll on Groote Eylandt and there is a high degree of confidence that this species is currently abundant and widespread in all suitable habitat types across the island. Northern Quolls are highly mobile and known to forage in disturbed habitats around roads and towns on Groote Eylandt, and have also been found to occur within areas of mine rehabilitation in the existing mine (Cumberland Ecology 2015).

The project will clear 1,525 ha (or 0.8%) of the 177,448 ha of forest and woodland habitat that occurs on Groote Eylandt. The project will temporarily remove a small percentage of breeding and foraging habitat for the Northern Quoll. However, the project site will be rehabilitated and, given the Northern Quoll has been found to utilise rehabilitated areas, the project is therefore considered unlikely to lead to a long term decrease in the size of the population of Northern Quolls on the island.

- *reduce the area of occupancy of the species*

The project will clear approximately 0.8% of the habitat available for this species on the island. However, the project will occur in a staged process and progressive rehabilitation will be undertaken. Areas that are disturbed will be rehabilitated back to forest and woodland habitats.



Northern Quolls have been demonstrated to use rehabilitated mine lands for foraging (Cumberland Ecology, 2015). For this reason, it is unlikely that the project will reduce the area of occupancy for the Northern Quoll in the long term.

➤ *fragment an existing population into two or more populations*

The project site is surrounded by a landscape featuring a mosaic of suitable habitat for the Northern Quoll. Haul road access to the project site will not fragment the habitat as the cleared corridor will be traversable by Northern Quolls, and the Quoll has been observed to forage in disturbed habitats around roads and towns.

The Northern Quoll occurs across the island in both disturbed and undisturbed habitats. The project will render some areas temporarily unsuitable until they are rehabilitated, but the project is unlikely to fragment the existing population into separate subpopulations.

➤ *adversely affect habitat critical to the survival of a species*

Critical habitat for the species is identified as any habitat where Northern Quolls are least exposed to threats or least likely to be in the future, which includes two broad habitat types: rocky areas and offshore islands (Hill and Ward, 2010). Groote Eylandt as a whole, is therefore considered to be habitat critical to the survival of the Northern Quoll.

Despite this, the project will only impact 0.8% of suitable habitat for the species, and the area disturbed will be progressively rehabilitated. Given the Northern Quoll has been observed foraging within areas of mine rehabilitation on the island, it is considered unlikely that the project will adversely affect habitat critical to the survival of this species.

➤ *disrupt the breeding cycle of a population*

The project is unlikely to disrupt the breeding cycle of the population of Northern Quolls on Groote Eylandt. Several breeding females were captured during field surveys, both within and outside the project site, and the Quoll is known to be prevalent across the island.

➤ *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The project will clear only a small proportion (0.8%) of habitat available for Northern Quoll on Groote Eylandt. Although the loss of this habitat may lead to a temporary decline in the occurrence of the Northern Quoll within the project site, it is unlikely to significantly impact the quoll population on Groote Eylandt, given that the disturbed area will be rehabilitated and mine rehabilitation has been confirmed during field surveys as providing habitat for quolls.



- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

The major threat to Northern Quolls on the mainland is the Cane Toad (*Rhinella marina*). Cane Toads are not present on Groote Eylandt, and the proponent actively seeks to ensure this invasive species is not inadvertently introduced to the island. The proponent has a Cane Toad Management Plan which includes quarantine measures to protect Groote Eylandt from Cane Toads.

Whilst transport to the island could act as a vector for Cane Toad introduction, the project will not exacerbate this risk beyond current levels. The activities associated with the project will therefore not increase the risk of establishment of an invasive species that is harmful to the Northern Quoll.

The proponent will implement feral animal control measures on the project site, including feral cat control (**see Chapter 8**). With the implementation of these measures, it is unlikely that feral cats will have a significant impact on the ecology of the project site, and are therefore not likely to significantly impact the Northern Quoll population.

- *introduce disease that may cause the species to decline, or*

The population of Northern Quoll on Groote Eylandt shows no evidence of decline and the species is present in all habitats on the island. On the mainland, significant declines have occurred but these appear largely attributable to the spread of Cane Toads (DotE, 2013r). There is no known disease threat to the Northern Quoll and no known diseases that are likely to be spread to the island as a result of the proposed mining.

- *interfere with the recovery of the species.*

Mining activities within the project site may interfere with the recovery of Northern Quolls within the project site. However, GEMCO has a Cane Toad Management Plan to manage the risks to the Northern Quoll from the Cane Toad. This plan will be implemented for the project site. The proponent also has a long term rehabilitation strategy in place for the existing mine that has seen the completed mined areas rehabilitated with native tree species.

## Conclusion

The population of the Northern Quoll on Groote Eylandt is known to be substantial, and it is recognised as an important population for the conservation of the species.

The project will result in the removal of 1,525 ha of habitat for the Northern Quoll, amounting to 0.8% of the available habitat on the island. Even if the mine site was not rehabilitated, extensive habitat would remain for this species on the island, given it occupies all terrestrial habitats. However, rehabilitation is proposed and forest and woodland will be restored on



the mine site in the long term. The Northern Quoll has been observed utilising the rehabilitated areas of the existing GEMCO mine, and this species is therefore expected to also utilise the rehabilitated areas of the project site.

The project will not cause the introduction of invasive species to the island, and will not increase the risk of disease or interfere with the recovery of the species.

Accordingly, no significant impact is predicted to occur to the Northern Quoll as result of the project.

## J.6 Northern Hopping-mouse

**Scientific Name:** *Notomys aquilo*

**EPBC Act Status:** Vulnerable

According to the Significant Impact Guidelines (DotE, 2013r), the concept of an 'important population' is central to assessing the potential for an action to have a significant impact on a Vulnerable species. An important population is defined as '*a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:*

- *key source populations either for breeding or dispersal*
- *populations that are necessary for maintaining genetic diversity, and/or*
- *populations that are near the limit of the species range.'*

Each of these points is addressed below.

- *Key source population either for breeding or dispersal*

The Northern Hopping-mouse population on Groote Eylandt is the largest known population of this species, despite the actual size of the population being unknown (Woinarski 2004a, Woinarski and Ward 2012b, EMS 2013; EMS 2014b). Being an island population, the Northern Hopping-mouse is also, in effect, "quarantined" from some of the threats that apply to populations on the mainland. For these reasons maintenance of the island population is necessary for the species long term survival and recovery.

The population of the Northern Hopping-mouse on Groote Eylandt is therefore recognised as a key source population, important for the long term conservation of the species.

- *Populations that are necessary for maintaining genetic diversity*

As the largest known population of the species (Woinarski, 2004a; Woinarski and Ward, 2012b), the population of the Northern Hopping-mouse on Groote Eylandt is considered necessary to maintain the genetic diversity of the species.

- *Populations that are near the limit of the species range*

The Northern Hopping-mouse is known to be restricted to the monsoonal tropics of northern Australia, and other than Groote Eylandt, has also been recorded in central and north-east Arnhem Land. This species' distribution is considered to be highly fragmented as the populations typically consist of isolated and disjunct subpopulations (Woinarski 2004a).





For the reasons outlined above, the population of the Northern Hopping-mouse that occurs on Groote Eylandt is considered to comprise an 'important population' as defined by the EPBC Act.

### **Significant Impact Criteria**

The Significant Impact Guidelines also define a number of criteria to determine if an action is likely to have a significant impact on a species listed as Vulnerable under the EPBC Act. Each of these criteria are addressed below.

*An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of an important population of a species*

Little is known about the structure, density or distribution of the populations of this species (Woinarski and Ward 2012, (Woinarski, 2004a). For Groote Eylandt, the species appears to occur patchily and does not occupy all potentially suitable habitat.

The project will clear approximately 1,125 ha of open forest, and sandstone woodland and rock outcrop habitat that is potentially suitable for the species. Although the area to be cleared represents 0.6% of the potential habitat on the island for the species, it is uncertain as to what proportion of the existing population will be impacted.

It is also unknown whether the Northern Hopping-mouse can colonise mine rehabilitation (Woinarski and Ward, 2012b). No individuals of Northern Hopping-mouse were observed during surveys of the rehabilitation areas of the existing mine that were undertaken for this project. It is noted, however, that this is a species difficult to record during field surveys and there are very few records of this species in undisturbed areas of Groote Eylandt.

Given little is known about this species on Groote Eylandt, a precautionary approach has been taken, and it is assumed that this project may lead to a long-term decrease in the size of the population on the island.

- *reduce the area of occupancy of an important population*

Little is known about the structure, density or distribution of the populations of this species (Woinarski and Ward 2012, (Woinarski, 2004a). For Groote Eylandt, the species occurs patchily and does not appear to occupy all potentially suitable habitat. Therefore, the project could potentially reduce the area of occupancy of the population of the Northern Hopping-mouse on the island.

- *fragment an existing important population into two or more populations*

The project will clear approximately 1,125 ha of potentially suitable for the species, which represents 0.6% of the potential habitat on the island. Although there is



uncertainty about the uniformity of spread of the species within potential habitat on the island, the species, being small, is likely to have a small home range. Therefore, given the large extent of potential habitat that will remain on the island, it is unlikely that the project will fragment the species into two or more populations.

- *adversely affect habitat critical to the survival of a species*

No critical habitat has been identified for this species on the project site.

- *disrupt the breeding cycle of an important population*

The project will clear approximately 1,125 ha of potentially suitable for the species, which represents 0.6% of the potential habitat on the island. Therefore, given the large extent of potential habitat that will remain on the island, it is unlikely that the breeding cycle of the Northern Hopping Mouse will be significantly disrupted across the island.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The project will clear only a small proportion (0.6%) of habitat available for the Northern Hopping-mouse on Groote Eylandt. This species has not been observed within the rehabilitated areas of the existing GEMCO mine, and it is therefore unknown if this species would colonise rehabilitated woodlands. Assuming the species does not inhabit these areas, it is likely that the project will modify and potentially destroy available habitat to the extent that it may impact species numbers, and contribute to the local population to declining.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

An as yet unconfirmed theory about mammal species declining in northern Australia is that they may fail to compete with introduced mammals such as the House Mouse and Black Rat (Fitzsimons *et al.*, 2010). It is conceivable that these invasive species could establish near the project site in the future, and may compete with the Northern Hopping-mouse for food and shelter resources within the project site.

- *introduce disease that may cause the species to decline, or*

An as yet unconfirmed theory about mammal species declining in northern Australia is that a disease or diseases may have been introduced with invasive mammals such as the House Mouse and Black Rat (Fitzsimons *et al.*, 2010). It is conceivable that such species could establish near the project site in the future, and could spread disease harmful to the Northern Hopping-mouse (Fitzsimons *et al.*, 2010).

- *interfere substantially with the recovery of the species.*



Given the project will clear only a small proportion (0.6%) of habitat available for the Northern Hopping-mouse on Groote Eylandt, it appears unlikely that the project will substantially interfere with the recovery of the species. However, more information is needed about the structure, density and distribution of the populations of this species on Groote Eylandt.

## **Conclusion**

The population of the Northern Hopping-mouse on Groote Eylandt is considered an important population. The project will result in the removal of 1,125 ha of potential habitat for this species, amounting to 0.6% of the available habitat for this species on the island. However, little is known about the structure, density or distribution of the populations of this species (Woinarski and Ward 2012, (Woinarski, 2004a). For Groote Eylandt, the species occurs patchily and does not appear to occupy all potentially suitable habitat.

The project has potential to result in the loss of habitat for the species, and there is no evidence that the species has, or will, recolonise within rehabilitated mine areas. Indirect impacts of mining could also include competition and the spread of disease from invasive species such as rodents.

As such, the project could potentially result in a significant impact on this species. Offsets will be provided for this impact, as discussed in the EIS Biodiversity Offset Strategy.



## J.7 Migratory Species

Two migratory fauna species listed under the EPBC Act have been recorded within the project site:

- Salt-water Crocodile (*Crocodylus porosus*); and
- Rainbow Bee-eater (*Merops ornatus*).

Although not recorded during current or previous surveys within the project site, the following migratory species, as listed under the EPBC Act, are considered to have a moderate likelihood of occurrence due to the presence of suitable habitat:

- Fork-tailed Swift (*Apus pacificus*);
- White-bellied Sea-eagle (*Haliaeetus leucogaster*); and
- Rufous Fantail (*Rhipidura rufifrons*).

Migratory species known or with the potential to occur within the project site have been grouped together in the assessment of significance presented below. Where required, individual species have been discussed separately.

### Important Habitat Assessment

According to the *Significant Impact Guidelines* (DotE, 2013r), the concept of an 'important habitat' is to be used when assessing the potential for an action to have a significant impact on a migratory species. The criteria for determining if an area equates to an 'important habitat' for a migratory species are addressed below for the five species listed above:

- *Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species*

The broad distribution of these five migratory species and their habitat preferences indicate that of the species found, or with the potential to occur on the project site, none would form ecologically significant proportions of the populations of these species. Although these species do, or could occur, within parts of the project site, these species are not anticipated to concentrate in large numbers within the project site. Rather, only a very small proportion of the Groote Eylandt population for each species would or could occur within the project site. Moreover, the predicted scale of impact to each migratory species is small, as explained below.

The habitats used and the likely extent of use is summarised for each species as follows:

- The Salt-water Crocodile occurs widely throughout the coastal areas of northern Australia, typically inhabiting reef, coastal and inland waterways. Small numbers of animals occur in the streams of the project site, but these would represent a very small proportion of the overall population of the



species on Groote Eylandt, as crocodiles occur in all major streams on the island, in lagoons and around the coastline.

- The Rainbow Bee-eater and Fork-tailed Swift occur across the entire mainland and are also found on various offshore islands. They have broad habitat preferences, and are typically found in forest and woodland habitat, which is the main habitat type across Groote Eylandt. These bird species would forage in the forest and woodland areas of the project site, but such habitats predominate across the island. Therefore, the project site would not support an ecologically significant proportion of the local population of these species.
- The White-bellied Sea-eagle occurs in primarily coastal areas of the mainland, including offshore islands, and is primarily found in association with permanent waters, including rivers, streams and coastal areas. The majority of the project site is unsuitable for this species. The limited areas of streams that may on occasion be used by foraging individuals would not support an ecologically significant proportion of the local population of the species.
- The Rufous Fantail occurs in coastal areas of the north and east of the mainland, including offshore islands, and is typically found in forest and woodland habitat, which is the main habitat type across Groote Eylandt. This bird would forage in the forest and woodland areas of the project site, but such habitats predominate across the island. Therefore, the project site would not support an ecologically significant proportion of the local population of these species.

➤ *Habitat that is of critical importance to the species at particular life-cycle stages*

The habitats that occur on the project site are not of critical importance for breeding for any of the migratory species listed above. While some species may breed on the project site, such animals would not concentrate such that a significant proportion of the breeding population was put at risk.

- The Salt-water Crocodile was recorded within the project site, in a perennial part of a tributary of the Amagula River. It is likely to breed in the larger and more permanent sections of the watercourses that occur in the project site. While such watercourses could be used for breeding by some animals, such habitat is not of critical importance to the occurrence of the species as a whole on Groote Eylandt. Moreover, such areas do not occur within the disturbance footprint and consequently will be avoided by the project.
- The Rainbow Bee-eater, Fork-tailed Swift and Rufous Fantail may feed and forage within the forest and woodland habitats of the project site, however, these habitats are widespread across Groote Eylandt. Therefore, only a small proportion of breeding pairs of these birds on Groote Eylandt would/could be impacted by the project. While forest and woodland could be important for breeding for some pairs of birds, such vegetation is not of critical importance to the occurrence of the species as a whole on Groote Eylandt.



- The White-bellied Sea-eagle is unlikely to breed in the area, but may forage over it occasionally. Foraging would be confined to permanent sections of watercourses in the project site. Such habitats are unlikely to be of critical importance to the species at any stage of their life cycle.
- *Habitat utilised by a migratory species which is at the limit of the species range*
- None of the habitat within the project site is at the limit of the ranges for these species: the Salt-water Crocodile, White-bellied Sea-eagle and Rufous Fantail occur across the majority of coastal northern Australia, and the Rainbow Bee-eater and Fork-tailed Swift, occur throughout much of mainland Australia and offshore islands.
- *Habitat within an area where the species is declining*
- Habitat is relatively pristine across the majority of Groote Eylandt. None of the migratory species known to occur, or considered to have potential to occur are considered to be declining within the project site or Groote Eylandt.

For the reasons outlined above, the project site is not considered to be important habitat for any of the migratory species listed above.

### **Significant Impact Criteria**

The Significant Impact Guidelines also define a number of criteria to determine if an action is likely to have a significant impact on a species listed as migratory under the EPBC Act. Each of these criteria are addressed below.

*An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:*

- *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

The habitat within the project site is not considered important habitat for any of the migratory species known to occur, or considered to have potential to occur, within the project site. A total of 1,525 ha will be cleared within the project site, and this equates to approximately 0.7% of the total area of Groote Eylandt.

The project will largely avoid any suitable habitat for the Salt-water Crocodile that may occur within the project site, such as riparian areas. The suitability of such habitat for the Salt-water Crocodile is reliant on seasonal conditions. The habitat present is not considered important for the long-term survival of the species within the locality due to the wide distribution and abundance of this species on Groote Eylandt.

The project will remove a small proportion of potential foraging habitat for the Rainbow Bee-eater, Fork-tailed Swift, White-bellied Sea-eagle and Rufous Fantail.



However, suitable foraging habitat for these species exists across the remainder of the island.

- *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species*

The habitat within the project site is not considered important habitat for any of the migratory species known to occur, or considered to have potential to occur, within the project site.

The only feral animals recorded in the project site that may be harmful to the migratory species were the Domestic Dog/Dingo hybrids and the Feral Cat. The proponent will implement feral animal control measures on the project site (**see Chapter 8**). With the implementation of these measures, it is unlikely that feral animals will have a significant impact on the ecology of the project site.

- *Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

As stated above, there is no evidence to suggest that the project site supports an ecologically significant proportion of the population of any of migratory species known to occur, or considered to have potential to occur, on the project site. Accordingly, the project will not disrupt an ecologically significant proportion of the population of any of these migratory species.

## Conclusion

The project site does not provide important habitat for any of the migratory species known to occur, or considered likely to occur within the project site. There is no evidence to suggest that the project site supports an ecologically significant proportion of the population of any of migratory species.

Accordingly, no significant impact is predicted to occur to the Salt-water Crocodile, Rainbow Bee-eater, Fork-tailed Swift, White-bellied Sea-eagle or Rufous Fantail as a result of the project.



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*Appendix K*

Dust Report

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## K.1 Introduction

Construction and mining activities have the potential to generate dust, which may extend the area of impact on flora and fauna beyond the area directly disturbed by the mine.

Dust that settles can accumulate on leaf surfaces and reduce essential physiological processes including photosynthesis, respiration, and transpiration (Farmer, 1993). Dust can also produce physical effects on plants such as blockage and damage to stomata, shading, and abrasion of the leaf surface or cuticle. Decreased growth and vigour of plants may mean that they are more susceptible to pathogens and other disturbance, and these plants are more likely to be subject to increased mortality. Such impacts to individual plants generally result in decreased productivity and can result in changes in vegetation and community structure (Farmer, 1993). The effect of dust deposition also affects animals that use plants, either as a source of food or habitat.

Increased levels of dust could impact vegetation within woodland communities, reducing health of some species along the edge of mined areas and roads. It could also impact upon potential foraging resources for wildlife.

A specific dust impact investigation was conducted as part of the EIS flora and fauna study to determine whether there was evidence that dust was having a significant detrimental impact upon native vegetation beside the parts of the existing GEMCO mine likely to be subject to elevated levels of dust. The study focussed on the haul road, as an area likely to experience elevated dusts levels. The study was done to assist in assessing the likely impacts of dust from mining related activities in the Eastern Leases.

Fauna were not deemed suitable for a dust investigation study as their mobility does not allow for practical assessment of dust impacts. Therefore flora, specifically vegetation community floristics (i.e species composition), was selected for the dust investigation as this allowed for the comparison of several variables relating to species composition and abundance, at various defined distances from dust sources.

## K.2 Methods

### K.2.1 *Field surveys*

Flora surveys were conducted between 1 October and 13 October 2014 (late dry season) within vegetation communities adjacent to the following three survey areas:

- A mine haul road within the existing GEMCO mine, which is subject to frequent usage by heavy mine vehicles. Dust control measures, such as water suppression, are utilised on this road. Monitoring locations were situated at various distances radiating out from the haul road based on the assumption that locations adjacent to the haul road would be subject to more dust than those located a significant distance [over 1 km] away from the haul road. This assumption is consistent with



the dust modelling of project haul roads, as documented in the EIS Air Quality Report;

- The Emerald River Road, an unsealed public access road which is subject to local, non-mine related traffic. No form of dust control is currently being applied to this road. As per the haul road, monitoring locations were situated at various distances from the road; and
- A control site, located within bushland in an area not subject to any traffic and sufficiently distant from any mine or regular traffic activities.

*i. Monitoring Locations*

A total of seven monitoring locations were established across the three survey areas (refer to **Figure K.1**):

- Mine Haul Road:
  - HR-38, located 38m east of the Mine Haul Road;
  - HR-500, located 500m east of the Mine Haul Road; and
  - HR-1300, located 1.3km west of the Mine Haul Road.
- Emerald River Road:
  - ER-20A, located 20m west of the Emerald River Road; and
  - ER-20B, located 20m west of the Emerald River Road, and to the south of ER-20A; and
  - ER-500, located 500m west of the Emerald River Road.
- Control Site:
  - CS, located within the Northern EL, approximately 800 m from the nearest public access track / recently used drill track.

Preliminary visual observations during the establishment of monitoring sites along Emerald River Road indicated that there was a high level of variability in the amount of dust very close to the road. Therefore, two separate locations were established within 20m of the Emerald River Road in order to capture this variability across the investigation quadrats.

*ii. Dust Impact Monitoring Sites and Quadrat Design*

Six dust impact monitoring sites were set up at each of the seven locations. The monitoring sites were undertaken at various distances emanating from the centreline of the Mine Haul Road and Emerald River Road, as well as at one control location. Each monitoring site consisted of three randomly placed 2 x 1 m quadrat replicates. A total of 126 quadrats (7 locations x 6 sites x 3 replicates) were monitored for the current study. Of these, 18 quadrats



were located within the Control Site (6 sites x 3 replicates). Monitoring locations are shown in **Figure K.1**.

All quadrats were located within a single vegetation community, to ensure that a comparison of the impacts of dust on community structure and composition was able to be undertaken across the various locations. The vegetation community *Eucalyptus tetradonta/ Eucalyptus miniata* open forest with low shrub or tussock grass was chosen for establishment of quadrats as this vegetation community is the most widespread community within the locality of the GEMCO mine.

All flora species present within the quadrats and the Projective Foliage Cover (PFC) of each species present within the quadrats was recorded. The PFC is the percentage of ground that is shaded by a vertical projection of the foliage of plants. The overall percentage cover of the following strata was also recorded:

- Bare Ground;
- Litter;
- Grasses;
- Shrubs;
- Other herbage; and
- Weeds.

Visual observations on the general health of the vegetation and presence/absence of dieback were also noted within each quadrat

### ***K.2.2 Statistical Analysis***

Dust investigation data was analysed using PRIMER 6 (Clarke and Gorley, 2006). The primary analyses conducted were non-parametric Multidimensional Scaling (MDS), Analysis of Similarity (ANOSIM) and Similarity Percentages (SIMPER). These tests were conducted on two separate data sets. The first data set included the PFC values for individual flora species recorded within the quadrats (Species PFC data). The second data set included the percentage cover values of the various strata present within the quadrats (Stratum cover data).

A MDS analysis incorporates all relevant data and displays outputs on a two-dimensional graph. This method is useful for analysing sets of data with multiple variables (e.g. multiple plant species) between sites as the data is interpreted visually, with sites that are more similar being placed closer together. The MDS test also produces a 2D stress value that indicates the degree of difficulty the program had in arranging the sites on the graph. A stress value of  $\leq 0.2$  is deemed to be acceptable. Results of similarity indicated by graphs with stress values between 0.2 and 0.3 should be treated with caution as increasing stress values are indicative of the data points being arbitrarily placed in 2D ordination space rather than showing similarity patterns



ANOSIM tests for differences between groups are conducted using the Global R statistic. The Global R statistic ranges in value from 0 – 1 where large values (close to 1) are suggestive of complete separation of groups, whilst small values (close to 0) indicate little separation between groups. It was hypothesised that the level of similarity in vegetation community composition between the Control Site and the three haul road sites (HR-38, HR-50 and HR-1300) would increase with increasing distance from the Haul Road.

The SIMPER procedure calculates levels of similarity between samples and determines the contribution of each factor (in these cases – the different plant species) to the similarity and/or dissimilarity between samples. It was hypothesised that, if dust was a factor influencing the composition of vegetated communities, similarity levels would be highest between sites experiencing similar levels of dust disturbance.

### K.3 Results

Approximately 40 plant species were recorded across the investigation sites. All quadrats occurred within the vegetation community *Eucalyptus tetradonta/ Eucalyptus miniata* open forest with low shrub or tussock grass understorey.

The species recorded were relatively consistent across the various locations although the PFC varied between sites. The most dominant genera were *Acacia* and *Hibbertia*. Weeds were largely absent from the investigation sites. A complete list of the species recorded within the investigation sites and the average PFC across the quadrats is provided in **Table K.1** below.

Table K.1 Average Percentage Cover (PFC) of Recorded Flora Species and Strata within the Dust Impact Investigation Sites

Species	HR-38 38 m from haul road		HR-500 500 m from haul road		HR-1300 1300 m from haul road		ER-20A 20 m from Emerald River Road		ER-20B 20 m from Emerald River Road		ER-500 500 m from Emerald River Road		CS Control Site	
	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error
<i>Acacia lamprocarpa</i>	4.17	1.01	3.50	1.32	4.06	1.71	1.72	0.74	1.89	0.77	0.50	0.27	1.11	0.84
<i>Acacia latescens</i>	0	0	0.67	0.29	0	0	0.72	0.54	0	0	0	0	0	0
<i>Acacia multisiliqua</i>	0	0	0	0	0	0	0	0	0.06	0.05	0	0	0	0
<i>Acacia oncinocarpa</i>	0	0	0	0	0	0	0.11	0.11	0	0	0	0	0.28	0.27
<i>Acacia torulosa</i>	0	0	0	0	0	0	0	0	1.39	0.77	0	0	1.00	0.36
<i>Acacia yirrkallensis</i>	0	0	1.72	1.11	0	0	0.22	0.13	3.44	1.03	3.78	1.73	0	0
<i>Alphitonia excelsa</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.44	0.27
<i>Alyxia spicata</i>	0	0	0	0	0	0	6.22	1.79	2.72	1.24	0	0	0	0
<i>Baloskion sp</i>	0.06	0.05	0	0	0	0	1.11	0.84	0	0	1.39	0.66	0	0
<i>Bossiaea bossiaecoides</i>	0	0	0	0	0	0	0	0	0	0	0.28	0.27	0	0
<i>Brachychiton paradoxa</i>	0.44	0.29	0.06	0.05	0.06	0.06	0.11	0.07	0.11	0.11	0	0	0.28	0.15
<i>Buchinania obovata</i>	1.00	0.16	1.67	0.4	1.33	0.37	0.11	0.07	1.39	0.62	0.67	0.29	0.22	0.13
<i>Callitris intratropica</i>	0	0	0	0	0	0	0.06	0.05	0.56	0.54	0	0	0	0
<i>Cassyrtha filiformis</i>	0.17	0.09	0	0	0	0	1.44	1.09	0.28	0.15	0	0	0	0
<i>Corymbia polycarpa</i>	1.11	0.26	0.72	0.11	1.11	0.25	0.22	0.10	0.83	0.27	0.28	0.11	0.11	0.07
<i>Distichostemon hispidulus</i>	1.56	0.85	0.06	0.05	0.17	0.09	0	0	0.06	0.05	0	0	0	0
<i>Erythrophloeum chlorostachys</i>	0	0	0	0	0	0	0.78	0.37	0.67	0.38	0	0	6.72	1.27
<i>Eucalyptus miniata</i>	0.06	0.05	0.17	0.12	0	0	0	0	0.33	0.27	0.11	0.11	0.22	0.13
<i>Eucalyptus tetradonta</i>	1.22	0.36	1.06	0.37	0.11	0.08	0.78	0.38	1.22	0.59	0.39	0.14	0.94	0.37
<i>Exocarpus latifolius</i>	0	0	0	0	0	0	2.28	1.17	0.56	0.25	0.33	0.27	0	0

Species	HR-38 38 m from haul road		HR-500 500 m from haul road		HR-1300 1300 m from haul road		ER-20A 20 m from Emerald River Road		ER-20B 20 m from Emerald River Road		ER-500 500 m from Emerald River Road		CS Control Site	
	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error
<i>Flemingia parviflora</i>	0	0	0	0	0.11	0.11	0	0	0	0	0	0	0	0
<i>Gompholobium subulatum</i>	0	0	0.22	0.13	0	0	0.22	0.13	0.39	0.18	0.11	0.07	0.11	0.11
<i>Grevillea heliosperma</i>	0.11	0.07	0.11	0.11	0	0	0	0	0	0	0.11	0.11	0.56	0.54
<i>Grevillea pteridifolia</i>	0	0	0.56	0.37	0	0	0.06	0.05	0	0	0.22	0.13	0	0
<i>Hakea arborescens</i>	0	0	0	0	1.39	1.43	0	0	0	0	0	0	0	0
<i>Helictes cana</i>	0.56	0.16	0.33	0.11	0.28	0.11	0	0	0	0	0.44	0.27	0.06	0.05
<i>Hibbertia complanata</i>	1.17	0.43	0.67	0.54	0	0	0.94	0.37	0.61	0.54	0	0	0	0
<i>Hibbertia oblongata</i>	0.50	0.29	0	0	0.11	0.11	0	0	0	0	0	0	0	0
<i>Hibbertia pilosa</i>	0.06	0.05	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hibbertia sphenandra</i>	0.17	0.12	0.50	0.14	0.28	0.14	0.06	0.05	0	0	0.11	0.07	0	0
<i>Kailarsenia suffruticosa</i>	0.39	0.14	0	0	1.33	0.43	0.06	0.05	0	0	0.17	0.09	0.11	0.07
<i>Lomandra tropica</i>	0.61	0.18	0.39	0.16	0.94	0.31	0.50	0.18	1.11	0.38	0.83	0.3	0.83	0.23
<i>Melaleuca viridiflora</i>	0	0	0	0	0	0	0	0	0	0	0	0	0.59	0.55
<i>Merrania dissecta*</i>	0	0	0	0	0.06	0.06	0	0	0	0	0	0	0	0
<i>Pandanus spiralis</i>	1.11	1.08	2.22	1.63	5.56	1.53	0	0	0	0	0.06	0.05	0.50	0.29
<i>Persoonia falcata</i>	0	0	0.11	0.11	0	0	0.11	0.07	0.11	0.11	0.28	0.15	0	0
<i>Petalostigma pubescens</i>	0.11	0.11	0.67	0.37	0	0	0.33	0.27	2.11	0.96	0.28	0.11	0.5	0.18
<i>Phyllanthus sp</i>	0.17	0.09	0.56	0.12	0.72	0.16	0.22	0.10	0.28	0.11	0.33	0.11	0.17	0.12
<i>Sersalisia sericea</i>	0	0	0	0	0	0	0.11	0.11	0	0	0	0	0.06	0.05
<i>Spermakoke elaiosoma</i>	0	0	1.56	0.34	1.61	0.53	0	0	0	0	0	0	1.22	0.49
<b>% bare ground</b>	0	0	3.61	0.77	17.22	4.00	3.33	1.30	1.78	0.55	12.78	3.24	7.5	0.71



Species	HR-38 38 m from haul road		HR-500 500 m from haul road		HR-1300 1300 m from haul road		ER-20A 20 m from Emerald River Road		ER-20B 20 m from Emerald River Road		ER-500 500 m from Emerald River Road		CS Control Site	
	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error	Average % Cover	Standard Error
% grasses	21.28	3.17	36.11	3.78	14.72	2.75	12.50	2.30	9.72	1.27	13.72	2.69	25.00	2.64
% other herbage	1.39	0.57	2.28	0.38	4.72	0.89	4.39	1.84	1.56	0.42	2.39	0.75	2.22	0.6
% shrubs	13.11	1.91	16.11	2.06	8.11	1.88	16.50	2.79	17.78	1.68	8.28	1.62	16.67	2.04
% litter	53.22	5.16	41.89	3.43	39.11	5.50	63.28	3.35	69.17	1.81	62.83	3.92	48.61	2.92
% weeds	0	0	0	0	0.01	0.01	0	0	0	0	0	0	0	0



The field observations determined that bands of dust are clearly discernible on the canopy and understorey of the vegetation. However there was no evidence of significant dust impacts at any of the sites such as crown dieback or dieback of any of the open forest strata. The vegetation was healthy despite the bands of dust. The PFC and stratum cover data indicate a significant level of vegetation cover in all quadrats, which supports the visual observations of a lack of dieback.

The MDS plot of the species composition data shows no clear separation in the species composition between quadrats from the different locations (**Graph K.1**). The spread seen for the various quadrats indicates a high level of variation in species composition. The level of variation differs between locations as indicated by the high level of spread across the 2D ordination space for some locations (e.g. ER-500) compared to low level of spread for other locations (e.g. HR-1300).

As samples that are more similar are placed closer together, the MDS plot indicates that there is a lot of similarity between the various quadrats from the Haul Road Area despite differences in the distance from the haul road, and thus levels of dust disturbance. This indicates that there is no significant difference between ground stratum vegetation from sites close to the haul road and those located over 1 km away.

While there appears to be some separation between the quadrats from the Haul Road area and the Control site, based on the placement in the 2D ordination space, some quadrats from the control sites appear to have a higher level of similarity with those from the Haul Road locations and Emerald River Road locations than other quadrats from the control sites.

However, given the high stress value of the MDS test (0.27), these results should be treated with caution as they may not be indicative of the true variation and similarity between quadrats (see **Section K 2.2**).

ANOSIM analyses showed that species composition was significantly different amongst locations across all sites (Global R = 0.46,  $p = 0.001$ ). The mid-range Global R value (0.46) indicates that there is a considerable level of overlap (nearly 50%) in the species composition between locations. The clustering of individual quadrats from different locations, as seen in the MDS plot (**Graph K.2**), supports the result of overlap in species composition.

The significant result ( $p = 0.001$ ) from the ANOSIM test indicates that despite this overlap, there are still significant differences in the species composition between locations. The differences in the spread patterns across the 2D ordination space, where some locations have a high spread whereas others are more clustered, supports the result that there are differences between locations.

Pair-wise ANOSIM comparisons showed that the species composition at the Control Site was significantly different to that of the Emerald River Road and Haul Road Sites (**Table K.2**).

However, the level of overlap in species composition between the control sites and the various impacted sites does not correspond with increasing or decreasing distance from a dust source (ie distance from the road), indicating that the proximity to a dust source is





unlikely to be the underlying cause for the differences seen. Therefore, the hypothesis that the level of similarity in vegetation community composition between the Control Site and the Haul Road sites (HR-38, HR-50 and HR-1300) would increase with increasing distance from the Haul Road was rejected.

The ANOSIM results are further supported by the SIMPER analysis, which show that the Emerald River Road Sites ER-20A and ER-20B have a dissimilarity level of 79.96% in their species composition despite the similarity in their proximity to a dust source.

As the differences seen in the species composition between locations do not correspond with the proximity to a dust source, the differences seen between locations are more likely due to natural variation or other factors than any impacts from dust disturbance.

While the patterns seen in the MDS analyses of the Species PFC data should be treated with a degree of caution given the high stress levels, the results of similarity between locations for the Species PFC data are supported by the results of the MDS analyses of the Stratum cover data, which also show high levels of similarity in the composition of the various strata at the different locations. ANOSIM analyses showed that although the strata composition was significantly different amongst locations across all sites (Global R = 0.26, p = 0.001), the R values indicate that there is a high level of overlap (almost 75%) in the strata composition between locations.

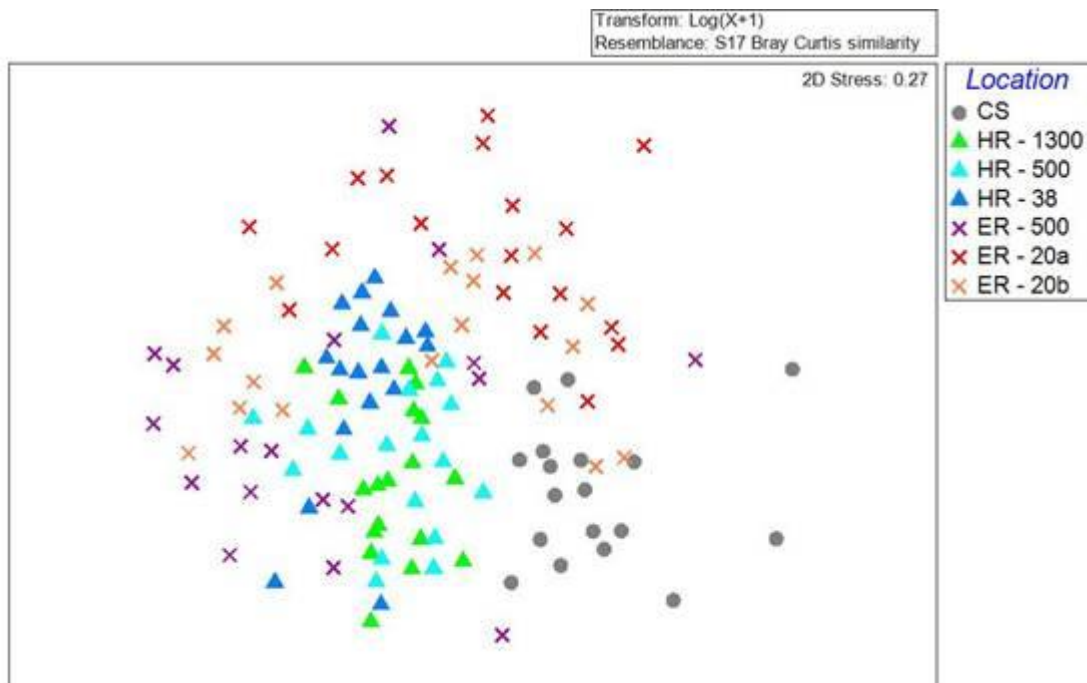
Pair-wise ANOSIM comparisons showed that although the strata composition at the Control Site was significantly different to that of the Emerald River Road and Haul Road Sites (**Table K.3**), once again, there was no discernible pattern to link the level of similarity with the control sites to the proximity of a dust source for the impact sites.

**Table K.2 ANOSIM Pair-wise comparisons between Impact and Control Sites (Species Composition)**

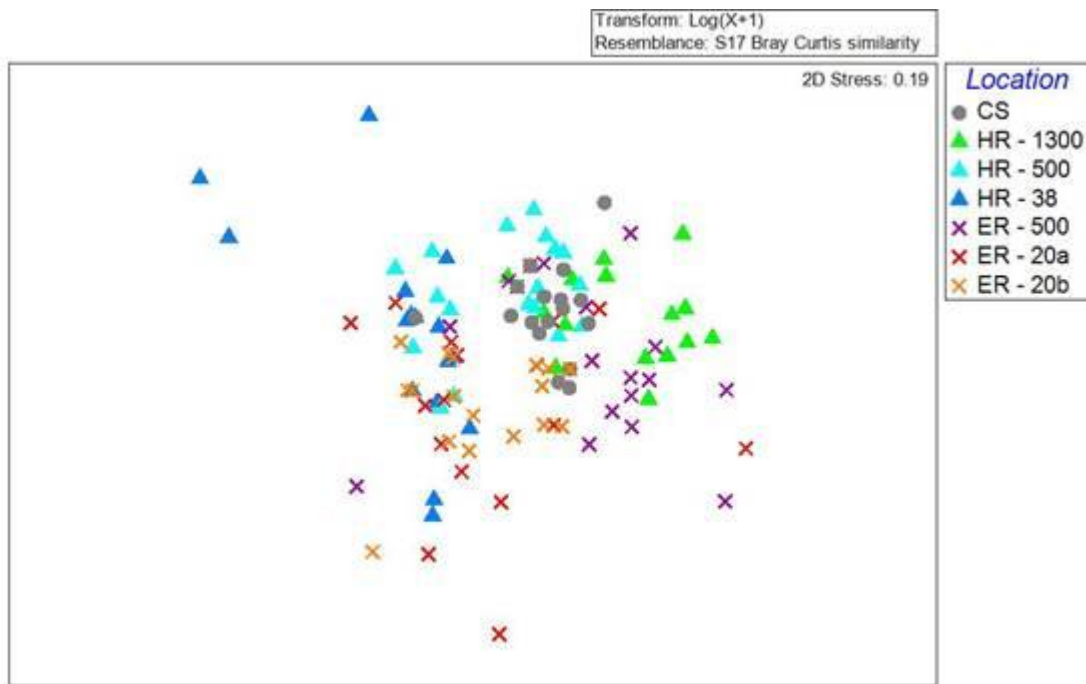
Pair wise Comparison	Global R	p- value	% of common species
CS & HR-1300	0.73	0.001	26.8
CS & HR-500	0.73	0.001	27.4
CS & HR-38	0.78	0.001	21.8
CS & ER-500	0.53	0.001	46.7
CS & ER-20a	0.66	0.001	34.0
CS & ER-20b	0.47	0.001	53.3

**Table K.3 ANOSIM Pair-wise comparisons between Impact and Control Sites (Strata Composition)**

Pair wise Comparison	Global R	p- value	% of common strata cover
CS & HR-1300	0.21	0.001	78.9
CS & HR-500	0.13	0.003	86.6
CS & HR-38	0.49	0.001	51.0
CS & ER-500	0.16	0.001	83.7
CS & ER-20a	0.27	0.001	73.0
CS & ER-20b	0.45	0.001	55.2



**Graph K.1 MDS ordination plot of community composition amongst site groups. Each symbol represents a quadrat replicate. The closer each pair of quadrats is on this graph, the more similar the quadrat vegetation is in terms of species composition.**



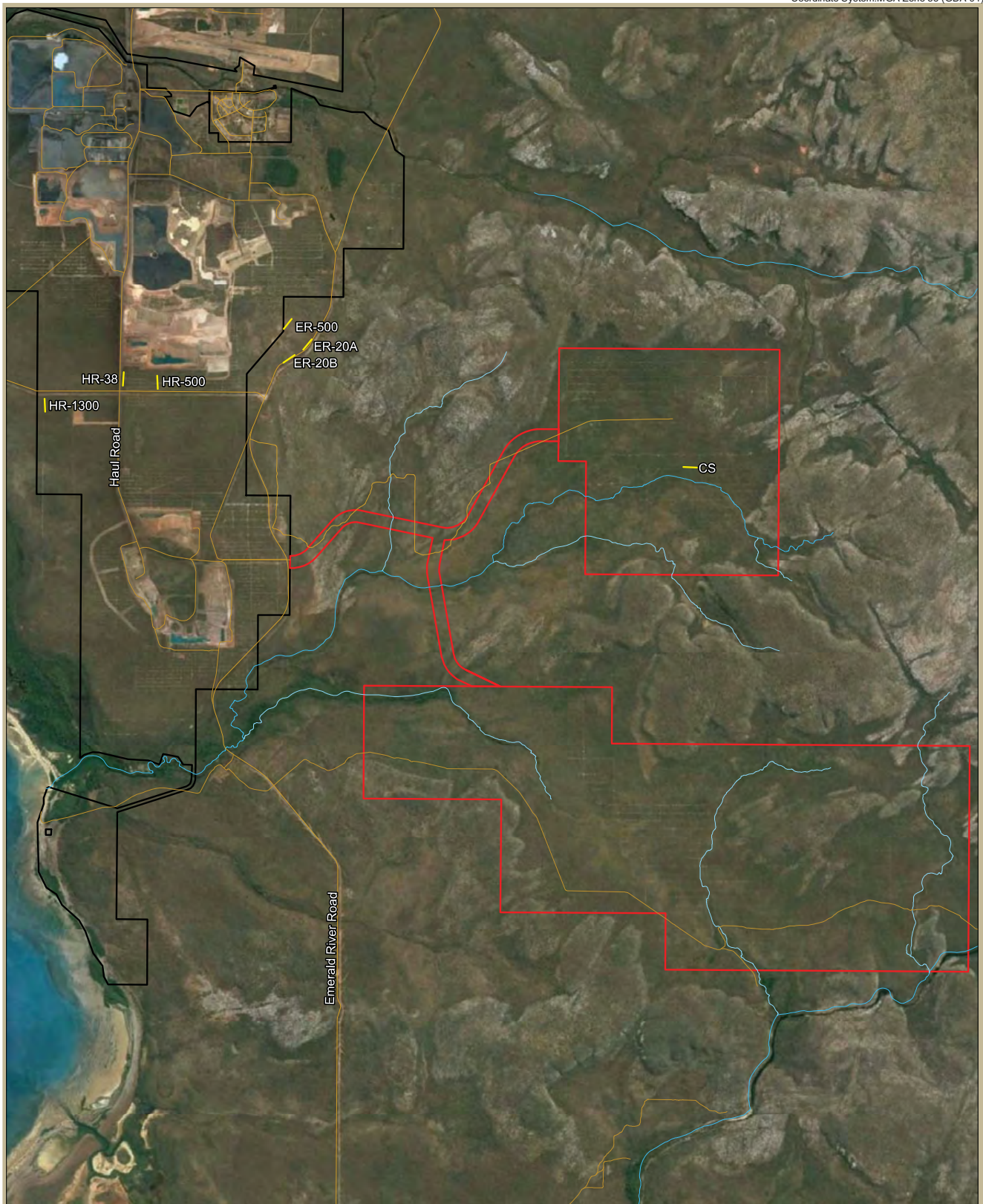
**Graph K.2 MDS ordination plot of strata composition amongst site groups. Each symbol represents a quadrat replicate**

## K.4 Conclusion

The species composition and strata composition of the vegetation communities show significant differences between the Control Site and the Haul Road locations, as well as between the Control Site and the Emerald River Road locations. However the quadrats within a location also show high levels of variation despite being in similar vicinity to dust sources. The differences seen in the species composition do not correspond with the proximity to a dust source. The differences seen between locations are more likely due to natural variation or other factors than any impacts from dust disturbance.

It is therefore concluded that dust disturbance is not the underlying cause for the differences seen in the community composition between sites. While dust can have potential indirect impacts on flora, this study did not provide any evidence that dust significantly alters the composition of vegetation communities.

Coordinate System: MGA Zone 53 (GDA 94)



- Legend**
- Project Site
  - Existing GEMCO Mine
  - Roads and Access Tracks
  - Watercourse
  - Flora Survey Location for Dust Impact Assessment

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Data Source:  
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I:\...14002\Figures\RP120141218\Figure K.1

Figure K.1. Dust Impact Assessment Locations

