Appendix 12
Vegetation and fauna assessment

VEGETATION AND FAUNA ASSESSMENT - PROPOSED RANGER 3 DEEPS UNDERGROUND MINE

PREPARED FOR
ENERGY RESOURCES OF AUSTRALIA LTD

3 July 2014

Explanatory note: Extent of above ground disturbance

The following vegetation and fauna assessment addresses the expected environmental impact of the proposed Ranger 3 Deeps underground mine as proposed in the referral documentation. At the time, the expected above-ground component of the project included clearing of vegetation within the Magela Land Application Area (Magela LAA) for a number of ventilation shafts within a 12 ha proposed vent corridor. The construction footprint of each shaft was not expected to exceed 0.25 ha with a total combined disturbance footprint of approximately 2 ha within the ventilation corridor.

Subsequent design and engineering investigations for the Project have revised the likely maximum extent and location of above ground ventilation infrastructure. With the exception of two new exhaust shafts, proposed to be constructed within the Magela LAA, it is not envisaged that any additional ventilation infrastructure will be constructed east of the main mine access road. Therefore the "proposed vent corridor" described in this report can be considered as describing the maximum extent of proposed infrastructure.

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Project Number	13DARECO-0014
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Abbreviations

Abbreviation	Description
API	Aerial photography interpretation
DEWHA	Department of the Environment, Water, Heritage and the Arts
DLRM	Department of Land Resource Management
DoE	Department of the Environment (formerly SEWPaC)
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
ERA	Energy Resources of Australia Ltd
GIS	Geographic Information System
LAA	Land Application Area
MLAA	Magela Land Application Area
MNES	Matters of National Environmental Significance
NP	National Park
NRETAS	Natural Resources, Environment, the Arts and Sport (now DLRM)
NT	Northern Territory
NVIS	National Vegetation Information System
RPA	Ranger Project Area
RP1	Retention Pond 1
RP 2	Retention Pond 2
SEWPaC	Department of Sustainability, Environment, Water, Populations and Communities (now DoE)
TO / TOs	Traditional Owner / s
TPWC Act	*Territory Parks and Wildlife Conservation Act*
TRARC	Tropical Rapid Appraisal of Riparian Condition
VAST	Vegetation, assets, states and transitions

Summary

Eco Logical Australia (ELA) was engaged by Energy Resources of Australia Ltd (ERA) to conduct flora and fauna studies to support the preparation of an Environmental Impact Statement (EIS) for the proposed Ranger 3 Deeps underground mine.

The above-ground component of the project would incorporate the construction of a number of ventilation shafts and associated infrastructure. The ventilation shafts would be located within a corridor approximately 12 hectares (ha) in size, situated directly adjacent to the existing mine operation. The construction footprint for each ventilation shaft is not expected to exceed 0.25 ha with a total combined disturbance footprint of approximately 2 ha within the vent corridor.

Flora and fauna studies encompassed the proposed vent corridor and the surrounding area including Magela Creek and Georgetown Billabong. The impact of the proposed clearing on Matters of National Environmental Significance (MNES), and species listed under Northern Territory threatened species legislation was assessed in the context of the site surrounds.

A Commonwealth Department of the Environment (DoE) Protected Matters database search of the proposed vent corridor (conducted 28 August 2013) identified two listed vulnerable plant species and one threatened ecological community. The plant species are also listed under the *Territory Parks and Wildlife Conservation Act* (TPWC Act). An additional three plant species are listed as vulnerable under the TPWC Act. None of these species have been recorded within the Ranger Project Area (RPA). Their potential to occur in or adjacent to this area is considered to be highly unlikely given that they are sandstone habitat specialists and many of them have highly restricted distributions. The Arnhem Plateau Sandstone Shrubland Complex threatened ecological community occurs 4 km from the survey area at its closest point.

Thirty-three vegetation communities were identified across the survey area. The cumulative and combined effects of various forms of disturbance are evident in the character and condition of these vegetation communities. The area has been subject to significant disturbance ranging from mostly mining related activities (such as irrigation and clearing) to naturally occurring events such as fire, flooding, storms/cyclones and impacts from feral pigs and weeds. The proposed vent corridor supports modified or substantially transformed native vegetation; non-native vegetation; or is completely cleared. Much of the wider survey area not affected by irrigation supports terrestrial vegetation subject to minimal modification (residual) with fire being the only disturbance. These areas are entirely outside of the proposed vent corridor and would not be disturbed during construction activities. Riparian vegetation communities in excellent and good condition occur almost entirely outside of the proposed vent corridor and would not be disturbed during construction activities.

Thirty-two fauna species listed as threatened or migratory were identified from a desktop literature review for the survey area. A range of survey methods were implemented in accordance with recommended survey guidelines for these species (DEWHA 2008 and 2010, SEWPaC 2011). A total of 125 fauna species were recorded during surveys, 23 of which occurred within or adjacent to the proposed vent corridor. Five migratory species and two threatened species were recorded in the

survey area, including the migratory Rainbow Bee-eater (*Merops ornatus*), which occurred within or just adjacent to the proposed vent corridor and at other locations and the TPWC Act threatened Fawn Antechinus (*Antechinus bellus*).

The impact of vegetation clearance and habitat fragmentation associated with the proposed development on Matters of National Environmental Significance (MNES) including world and national heritage places, wetlands of international significance and listed threatened and migratory species was assessed using the Commonwealth's significant impact guidelines (Commonwealth of Australia 2009).

It is considered highly unlikely that disturbance associated with this project will have a significant impact on any of the MNES considered, given the small footprint of the project, its location within heavily disturbed habitat and the distance to recorded threatened flora species and the threatened sandstone ecological communities.

1 INTRODUCTION

1.1 PROJECT DESCRIPTION

Eco Logical Australia Pty Ltd (ELA) was engaged by Energy Resources of Australia Ltd (ERA) to undertake flora and fauna investigations related to the proposed Ranger 3 Deeps underground mine (the Project), as per Scope of Works 61800 (ERA Major Projects). The Ranger 3 Deeps project is described in section 1.3.

ERA is required to prepare an Environmental Impact Statement (EIS) in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Northern Territory *Environmental Assessment Act*, and has been issued with '*Guidelines for the preparation of an Environmental impact statement, Ranger 3 Deeps underground mine, Energy Resources of Australia Ltd*' (NT EPA and SEWPAC 2013). In accordance with these guidelines, ERA is required to assess the potential impact of the underground mine on threatened and migratory species.

Flora and fauna investigations were undertaken by ELA to address various elements of the ERA scope of works (SoW) and EIS guidelines, and are presented in the following sections of this report:

Section 1 *Project description*

Section 2 *Desktop review and likelihood analysis*

ELA conducted a review of available information to determine the likelihood of occurrence of threatened flora and fauna species and threatened ecological communities. This information was used to guide field efforts.

Section 3 *Characterise the potential habitat of threatened species in the study area including vegetation types, and other identifiable features (ERA SoW)*

ELA has undertaken vegetation mapping and vegetation condition assessments in the nominated survey area.

Section 4 *Undertake baseline surveys for reptiles, birds and mammals (including microbats) (ERA SoW)*

Carry out targeted surveys for threatened EPBC and NT listed fauna species that may occur in the study area (ERA SoW)

ELA has undertaken a fauna survey to determine the presence of identified listed fauna species, as well as reptiles, birds and mammals (including microbats).

Section 5 *Characterise the potential habitat of threatened species in the study area including vegetation types, and other identifiable features (ERA SoW)*

ELA has undertaken an assessment of habitat values throughout the survey area.

Section 6 *Potential impact analysis (EIS guidelines)*

Potential impacts of the proposed development on flora and fauna are identified in the EIS guidelines (NT EPA and SEWPaC 2013). Eco Logical Australia undertook an assessment of the potential impacts of vegetation clearance and habitat fragmentation on Matters of National Environmental Significance (MNES) in relation to the *EPBC Act Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Commonwealth of Australia 2009). MNES relevant to this assessment include world and national heritage places, wetlands of international significance, listed ecological communities, and listed threatened and migratory species.

1.2 SURVEY AREA

The proposed vent corridor covers approximately 12 ha of woodland and cleared areas adjacent to the existing Ranger mine site. Approximately 2 ha of this 12 ha area will be cleared for the project, although the actual area of vegetation clearance will be determined by final design and construction requirements. To support an assessment of the potential impact of the development and operation of the proposed Ranger 3 Deeps underground mine, and in particular the establishment of above ground infrastructure required for the operation of ventilation equipment, vegetation community and fauna surveys were conducted over approximately 220 ha (Figure 1). The area was selected to include Magela Creek and the associated riparian vegetation corridor, Georgetown Billabong, and the transition between riparian and woodland vegetation. Targeted wetland surveys were also conducted at Retention Pond 1 (RP1) outside of the survey area (Figure 1).

1.3 THE RANGER 3 DEEPS PROJECT

The Project is situated within the footprint of the current Ranger Project Area (RPA), located 260 km east of Darwin and 11 km east of the regional centre of Jabiru (Figure 2). The Project lies immediately adjacent to the existing Ranger Pit 3 (Figure 3).

All surface infrastructure and land disturbance will occur within or adjacent to the existing footprint of current mining operations (Figure 3). Primary surface infrastructure will comprise a number of ventilation shafts constructed in the vicinity of the decommissioned Magela Land Application Area (MLAA) within a defined ventilation corridor. Ancillary surface infrastructure for the Project will comprise a paste backfill plant, refrigeration plant(s) and additional power generation. Disturbance within the MLAA will consist of above-ground ventilation shafts, an access track, power reticulation and discrete footings or foundations for each vent shaft. This infrastructure will augment the existing ventilation system required to maintain air quality. Mining will be by a series of drive and stope developments, accessed via a decline allowing material transport to the surface in trucks. The main mine workings will be greater than 300 m below the surface (Figure 4).

Figure 1: Proposed vent corridor within the survey area and RP1 outside the survey area

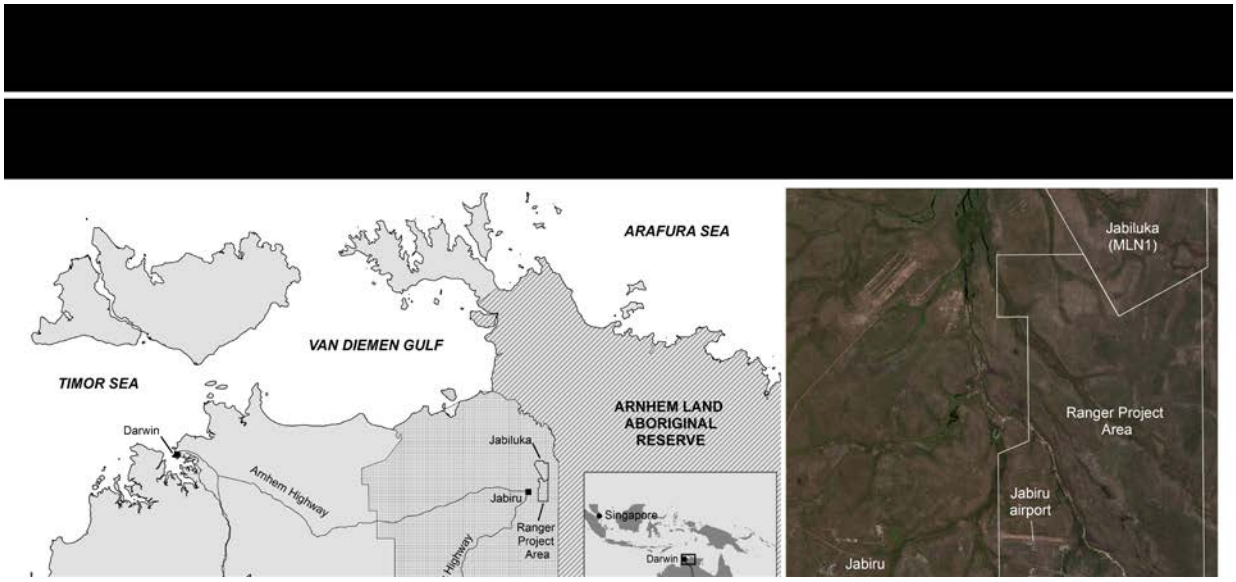

Figure 2: Location of Ranger Project Area (RPA) (source: ERA)

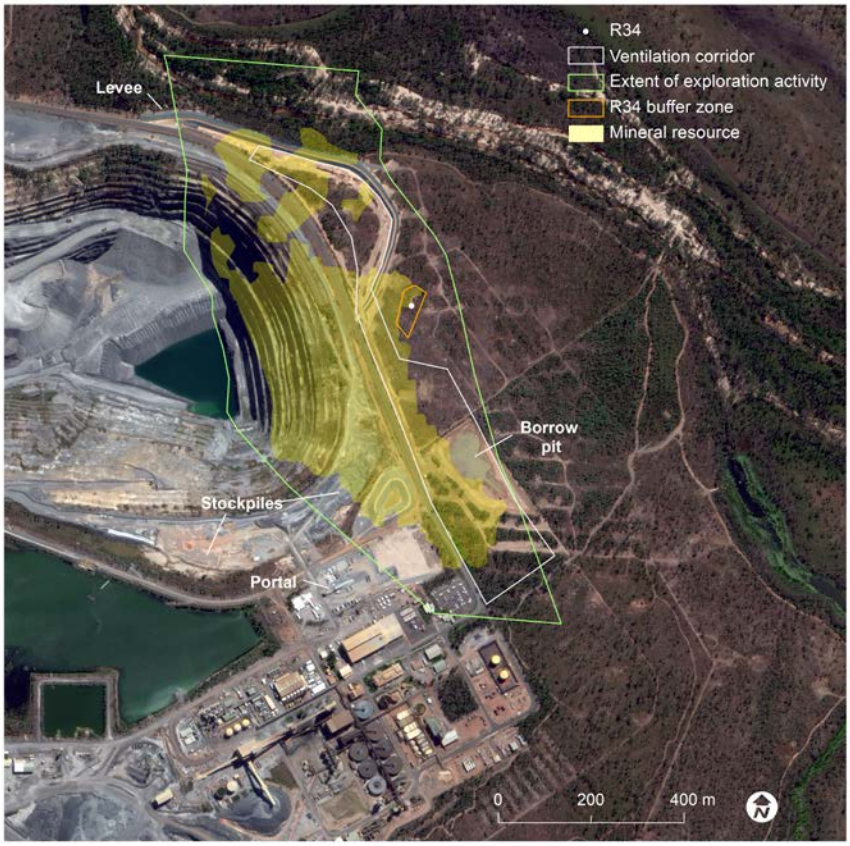

Figure 3: Ranger 3 Deeps project area including the existing Ranger Pit 3 (Source: ERA)

Once completed, each ventilation shaft will occupy a small footprint, with an anticipated diameter of 3 to 5 m for the shaft plus supporting infrastructure. Including a buffer zone and fencing if required, each of these areas might be of the order of 0.05 ha. The refrigeration plant will be located adjacent to

the intake shaft and will not significantly change the completed footprint area. During construction of each vent shaft a larger area will be required to enable access for heavy equipment and construction activity. This area is not expected to exceed 50 x 50 m (0.25 ha) for each ventilation shaft. There will also be a requirement to construct or upgrade access tracks to each location, however the distances are small due to the proximity of the ventilation corridor to the existing mine access road. Power reticulation will also require some minor clearing for both access and construction of the transmission infrastructure. Combined, the total land disturbance outside of the mine access road, within the proposed ventilation corridor is not expected to exceed 2 ha. The construction is anticipated to occur predominantly within the first year of the proposed activity; although there may be progressive works as new areas of the underground mine are developed. All such development will continue to occur within the defined corridor, or existing mine and plant areas.

Apart from vegetation clearance and the movement of heavy equipment and vehicles associated with the infrastructure development, other main vectors for potential impact to threatened and migratory species include: short range noise associated with the operation of surface based fans; and localised deposition of dust or other airborne contaminants from the ventilation shafts. Preliminary investigation suggests that further air quality modelling will demonstrate the quantities are significantly below standard criteria.

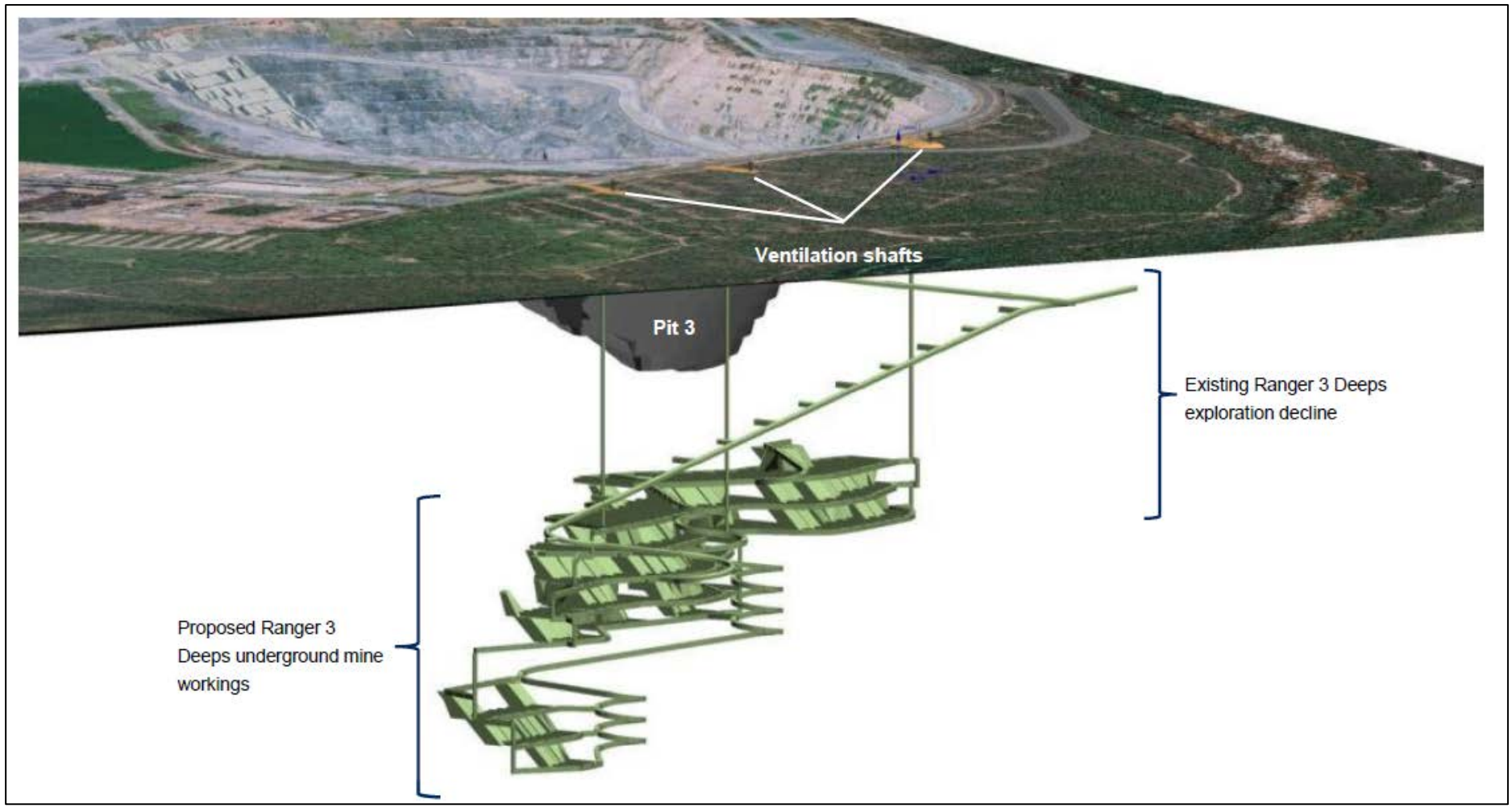

Figure 4: Provisional layout of potential mining areas (Source: ERA)

2 DESKTOP REVIEW AND LIKELIHOOD ANALYSIS

2.1 METHODS

2.1.1 Threatened Flora Species and Ecological Communities

The following database searches were undertaken to identify potentially occurring threatened flora species and actual threatened species records in the vicinity of the survey area:

- Commonwealth Department of the Environment (DoE) Protected Matters database, 28 August 2013
- Flora Atlas NT, Department of Land Resource Management (DLRM), 30 October 2013.

The Flora Atlas NT contains all the survey data available from the NT DLRM and is frequently updated with the survey data from the NT Herbarium. Records within 10 km of the survey area were identified.

An assessment of the likelihood of listed flora species potential occurring in the study area was undertaken through a desktop review, of the threatened species fact sheets and other information published by the DoE and the DLRM, and habitat information.

2.1.2 Threatened and Migratory Fauna Species

The following database searches were undertaken to identify potentially occurring threatened and migratory fauna species in the vicinity of the survey area:

- Commonwealth DoE Protected Matters database, 28 August 2013
- NT Fauna Atlas, DLRM, 30 October 2013.

An assessment of the likelihood of listed species potentially occurring in the study area was generated from desktop review, including the recent literature review of fauna surveys (ENV Australia 2012), the threatened species fact sheets and other information published by the DoE and the DLRM and habitat information.

2.2 RESULTS

2.2.1 Threatened Flora Species and Ecological Communities

The search of the Commonwealth DoE Protected Matters database identified one critically endangered, two vulnerable plant species and one threatened ecological community. The species are listed as critically endangered, vulnerable and data deficient data deficient under the TPWC Act (Table 1).

Table 1: EPBC and TPWC listed flora species, the EPBC threatened ecological community, and their likelihood of occurrence in the survey area

Name	EPBC status	TPWC status	Likelihood of Occurrence*	Distance** to Survey Area
Arnhem Plateau Sandstone Shrubland Complex	Threatened ecological community	Not listed	Highly unlikely	4 km
Acacia sp. Graveside Gorge	Critically Endangered	Critically Endangered	Highly unlikely	Incorrect record: 5 km Actual record: 77 km
Hibiscus brennanii	Vulnerable	Vulnerable	Highly unlikely	9 km
Sauropus filicinus	Vulnerable	Data deficient	Highly unlikely	9 km
Hibbertia brennanii	Not listed	Vulnerable	Highly unlikely	9 km
Hibbertia tricornis	Not listed	Vulnerable	Highly unlikely	9 km
Lithomyrtus linariifolia	Not listed	Vulnerable	Highly unlikely	9 km

*Likelihood definitions:
'Known' = the species has been recorded within the survey area within the last decade.
'Likely' = a medium to high probability that a species uses the survey area. The species has been recorded within the local area and habitat within the site is considered to be highly suitable.
'Possible' = a medium to low probability that a species used the survey area. The species has been recorded within the local area or region and habitat within the site is considered to be moderately suitable.
'Unlikely' = a very low to low probability that a species uses the survey area. The species may or may not occur locally or regionally, however based on the known habitat requirements of the species, and habitat available within the site, the site is considered unlikely to be suitable or marginal at best.
'Highly unlikely'= habitat on and in the vicinity is highly unsuitable for the species. Based on the known habitat requirements of the species, the site lacks the required habitat.
**Distance has been recorded to nearest whole kilometre

An additional four threatened flora species listed under the TPWC Act were identified in the search of the Flora Atlas NT. Scrutiny of the data revealed that some records were very old and uncertainty regarding their location was extremely high given a mapping scale of 1: 1,000,000. Consequently, only validated occurrences of these old records were considered in the assessment. Full details of the flora species distribution, known locations, habitats and the likelihood assessment are available at Appendix A and a summary is provided in Table 1.

The closest section of the listed threatened ecological community Arnhem Plateau Sandstone Shrubland Complex is the Mount Brockman massif, approximately 4 km from the survey area (indicative mapping sourced from SEWPaC 2011a).

All of the threatened plant species records were located approximately 9 km from the survey area (except *Acacia* sp. Graveside Gorge which was incorrectly recorded 5 km from the survey area; Figure 5). None of the recorded threatened flora species were located within the survey area or the RPA. Their potential to occur in these areas is highly unlikely, since:

- their habitats are associated with sandstone heathland, which does not exist on the RPA
- most have highly restricted distributions.

As there were no threatened flora species or ecological communities considered likely to occur within the survey area (Table 1), targeted surveys for threatened flora were not conducted. Flora species recorded during the vegetation community mapping were however, reviewed for threatened species status (section 3.2.3).

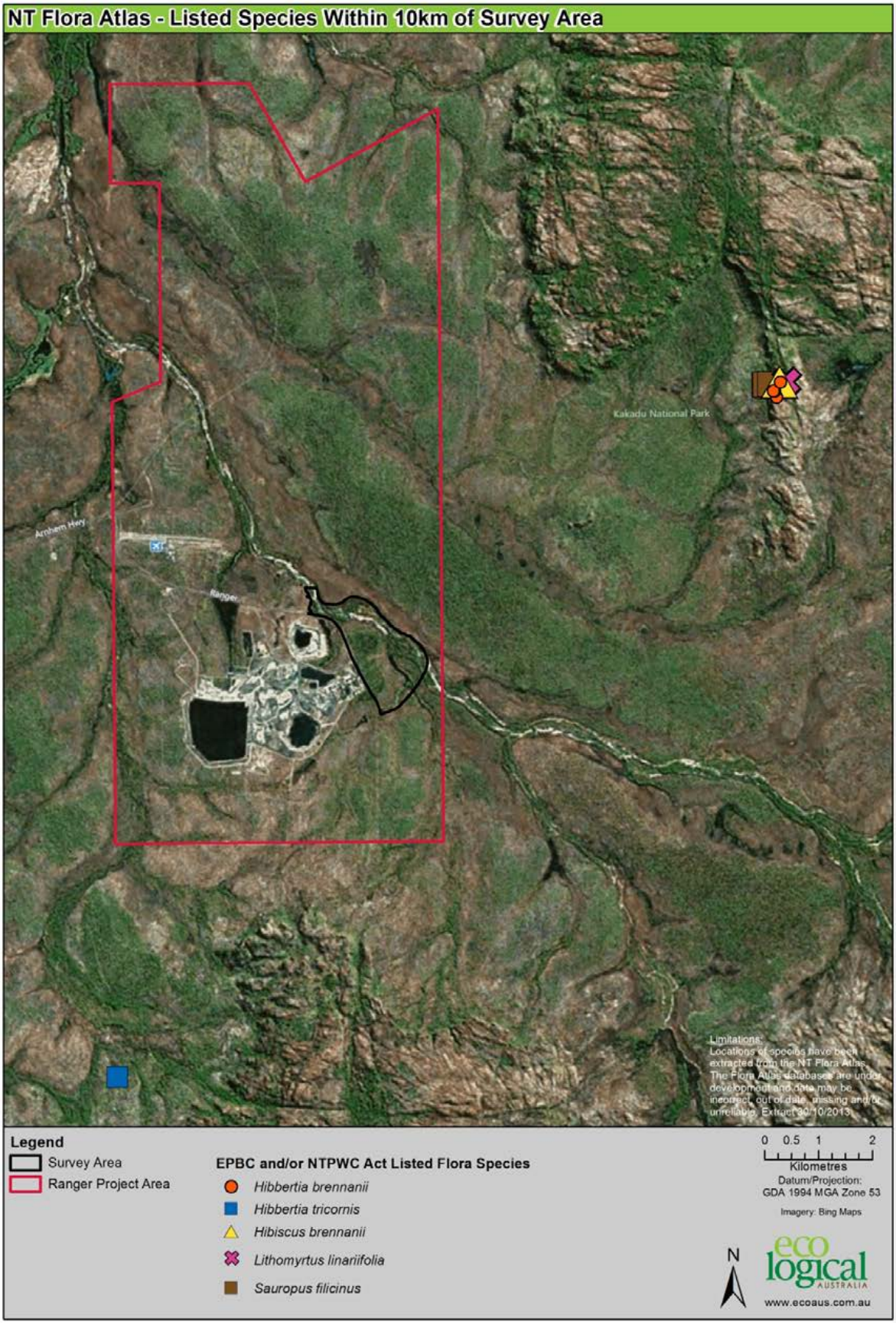

Figure 5: EPBC and TPWC Act listed flora species within 10 km of the survey area

2.2.2 Threatened and Migratory Fauna Species

The search of the Commonwealth DoE Protected Matters database identified 21 bird species, six mammal species and three reptile species. Two additional mammal species are listed as threatened under the TPWC Act but not under EPBC legislation.

Full details are available in Appendices B and C and a summary is provided in Table 2. Species that were assessed as 'known' or 'likely' to occur were prioritised when determining survey effort. Species that were common in the area prior to their significant declines since the late 1980s (Brush-tailed Rabbit-rat (*Conilurus penicillatus*) and the Northern Quoll (*Dasyurus hallucatus*)) were rated as 'possible'.

Table 2: EPBC and TPWC listed fauna species and their likelihood of occurrence

Common name	EPBC status	TPWC status	Likelihood of occurrence*
EPBC threatened bird species			
Eastern Partridge Pigeon *Geophaps smithii smithii*	Vulnerable	Vulnerable	Known
Gouldian Finch *Erythrura gouldiae*	Endangered, migratory	Vulnerable	Possible
Northern Masked Owl *Tyto novaehollandiae kimberli*	Vulnerable	Vulnerable	Likely
Red Goshawk *Erythrotriorchis radiatus*	Vulnerable	Vulnerable	Likely
Yellow Chat *Epthianura crocea tunneyi*	Endangered	Endangered	Unlikely
EPBC threatened mammal species			
Arnhem Land Rock-rat *Zyzomys maini*	Vulnerable	Vulnerable	Unlikely
Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus nudicluniatus*	Critically endangered	Not listed	Likely
Brush-tailed Rabbit-rat *Conilurus penicillatus*	Vulnerable	Endangered	Possible (formerly 'known')
Golden-backed Tree-rat *Mesembriomys macrurus*	Vulnerable	Critically endangered	Possible
Northern Brush-tailed Phascogale *Phascogale pirata*	Vulnerable	Endangered	Possible
Northern Quoll *Dasyurus hallucatus*	Endangered	Critically endangered	Possible (formerly 'known')

Common name	EPBC status	TPWC status	Likelihood of occurrence*
EPBC threatened reptile species			
Arnhem Land Egernia *Bellatorias obiri*	Endangered	Endangered	Highly unlikely
Plains Death Adder *Acanthophis hawkei*	Vulnerable	Vulnerable	Highly unlikely
EPBC migratory bird species			
Barn Swallow *Hirundo rustica*	Migratory	Not listed	Possible
Cattle Egret *Ardea ibis*	Migratory	Not listed	Known
Common Sandpiper *Actitis hypoleucos*	Migratory	Not listed	Known
Derby White-browed Robin *Poecilodryas superciliosa cerviniventris*	Migratory	Not listed	Likely
Eastern Great Egret *Ardea modesta*	Migratory	Not listed	Known
Gouldian Finch *Erythrura gouldiae*	Endangered, migratory	Vulnerable	Possible
Grey Plover *Pluvialis squatarola*	Migratory	Not listed	Possible
Marsh Sandpiper *Tringa stagnatilis*	Migratory	Not listed	Known
Melville Cicadabird *Coracina tenuirostris melvillensis*	Migratory	Not listed	Likely
Oriental Plover *Charadrius veredus*	Migratory	Not listed	Likely
Oriental Pratincole *Glareola maldivarum*	Migratory	Not listed	Likely
Rainbow Bee-eater *Merops ornatus*	Migratory	Not listed	Known
Rufous Fantail *Rhipidura rufifrons*	Migratory	Not listed	Likely
Terek Sandpiper *Xenus cinereus*	Migratory	Not listed	Likely

Common name	EPBC status	TPWC status	Likelihood of occurrence*
Whimbrel *Numenius phaeopus*	Migratory	Not listed	Known
White-bellied Sea-Eagle *Haliaeetus leucogaster*	Migratory	Not listed	Known
EPBC migratory reptile species			
Saltwater Crocodile *Crocodylus porosus*	Migratory	Not listed	Known
TPWC threatened mammals			
Fawn Antechinus *Antechinus bellus*	Not listed	Endangered	Known

*Likelihood definitions:
'Known' = the species has been recorded within the project area within the last decade.
'Likely' = a medium to high probability that a species uses the site. The species has been recorded within the local area and habitat within the site is considered to be highly suitable.
'Possible' = a medium to low probability that a species used the site. The species has been recorded within the local area or region and habitat within the site is considered to be moderately suitable.
'Unlikely' = a very low to low probability that a species uses the site. The species may or may not occur locally or regionally, however based on the known habitat requirements of the species, and habitat available within the site, the site is considered unlikely to be suitable or marginal at best.
'Highly unlikely'= habitat on site and in the vicinity is highly unsuitable for the species. Based on the known habitat requirements of the species, the site lacks the required habitat.

3 VEGETATION AND FLORA

The EIS guidelines for the Ranger 3 Deeps project require an adequate assessment of the proposed actions and provision of 'details of the vegetation community types occurring on and adjacent to the proposal location, particularly including any species of flora and fauna conservation significance' under Part 3 of the EPBC Act and / or the NT TPWC Act (NT EPA and SEWPaC 2013).

ELA conducted vegetation community mapping to:

- provide local context for the environmental impact assessment of the proposed action
- provide a baseline for the identification of fauna habitats and fauna habitat resources (see section 5)
- detail the environmental status of the area.

Vegetation condition was assessed to take into account past and present land use, disturbances and land management, hence providing an overview of the cumulative effects of these impacts on vegetation communities.

3.1 METHODS

3.1.1 Vegetation Community Mapping

Vegetation community mapping was undertaken in three stages:

1. digital desktop review and draft vegetation community mapping and attribution undertaken prior to field surveys using aerial photograph interpretation (API) techniques and Geographic Information Systems (GIS) software (ESRI ArcMap 10.0);

2. collection of detailed site data during field surveys conducted in September 2013 to validate the draft mapping; and

3. final mapping incorporating field survey data.

Desktop Review and Draft Vegetation Community Mapping

A draft vegetation community map was developed prior to field work, using API and site-specific survey data. The API was based on high resolution 50 cm pan-sharpened WorldView-2 satellite imagery from 2012 (which was later updated to the June 2013 image).

The delineation of draft vegetation community boundaries (polygons) relied heavily on the identification of patterns and tones in the imagery. The interrogation of available site-specific survey data such as flora surveys undertaken in 2009 (Addison 2011), and contour mapping, assisted in the identification of vegetation boundaries and was used to broadly extrapolate and assign National Vegetation Information System (NVIS, DoE 2013a) Level 3 vegetation community classifications to all polygons (e.g. *Eucalyptus* open woodland, *Acacia* shrubland). The NVIS attributes are a systematic way

to describe vegetation communities at six levels depending on the floristic and structural information available. Level 6 provides the greatest level of detail.

A desktop review of botanical and other relevant information available for the proposed vent corridor and survey area was conducted, including:

- previous flora surveys (Addison 2011) and vegetation maps (Schodde et al. 1987)
- past and present disturbances such as irrigation (Chartres et al. 1991, Welch and Meek 2004, Addison et al. 2005), fire (e.g. Addison 2011,McIntyre 2011),and weeds (Gellert and McIntyre 2011).

A pre-field survey assessment was conducted using information from the desktop review, the draft vegetation map, satellite imagery and topographic maps. This assessment identified the general landscapes and vegetation communities of the area and potential habitats for listed threatened flora and fauna and migratory species.

Field Survey

Field validation of the draft vegetation community mapping was conducted by ELA botanists Ian Dixon, Sarah Dalgleish and Anja Zimmermann concurrently with the fauna surveys reported later in this document (between 4 and 11 September 2013).Vegetation community surveys followed the 'NT Guidelines and Field Methodology for Vegetation Survey Mapping' (Brocklehurst et al. 2007), which are compatible with the NVIS (DoE 2013a) and 'Australian Vegetation Survey Guidelines' (Hnatiuk et al. 2009). These are nationally recognised standards for surveying, classifying and mapping vegetation communities. A vegetation community is defined under the NVIS as 'an assemblage of plant species which are structurally and floristically similar and form a repeating unit across the landscape' (Brocklehurst et al. 2007: p. 3).

All accessible polygons on the draft vegetation map were inspected and verified, with vegetation community boundaries adjusted where necessary.

Detailed vegetation community surveys were undertaken in representative areas. The data are used to fully describe and typify these vegetation communities. In addition, general vegetation community descriptions were undertaken to validate the polygons on the draft vegetation map and provide more information on vegetation community condition. Coordinates and photos were taken of every detailed survey site and representative examples of the general survey sites (see Appendix D for coordinates and Appendix E for photos).

Both survey intensity levels provided validated information for the identification, attribution, distribution and condition of the vegetation communities in the survey area. The resulting final vegetation community map is in line with the NVIS methodology and standard.

General Vegetation Community Descriptions

In addition to the detailed surveys, 55 general vegetation descriptions were undertaken to validate the polygons on the draft vegetation map and to provide more detailed information on the condition of the vegetation community in the survey area. Areas with changes in vegetation, significant vegetation

or landscape features (e.g. creek lines), or those with a complex disturbance history were targeted. The general vegetation community descriptions included an identification of the main flora species, the height and density classes of the main vegetation strata (e.g. upper, mid and lower stratum) and a condition assessment. The level of detail recorded allows for vegetation community descriptions up to NVIS Level 5.

Detailed Vegetation Community Survey

Thirty-eight sites were surveyed in detail with the aim of fully describing and typifying each of the vegetation communities in the survey area in accordance with the standardised methodology for NT vegetation survey mapping (Brocklehurst et al. 2007) (Appendix F). This level of survey facilitates a greater degree of certainty in the differentiation of the vegetation communities at the initial stage of field survey.

The detailed survey recorded all plant species; their heights and percentage cover within minimum 20 m x 20 m quadrats (Appendix G). The size and shape of the sampling area was adjusted according to the density, heterogeneity and shape of the vegetation community. Average heights and percentage covers for each stratum (upper, mid and ground-storeys) and the average composition of the ground cover (percentage bare ground, litter, vegetation, crust, exposed rock and gravel) were recorded. Site attributes recorded included: the presence, percentage and frequency of site disturbance; the frequency and inferred intensity of fire; site drainage; nearest water source; climatic stress of plants assessed by leaf loss and other crown attributes; grazing; and general comments about the site, location, condition and history. The level of detail recorded allows for vegetation community descriptions up to NVIS Level 6.

Final Vegetation Community Mapping

Information derived from the general and detailed surveys was used for the amalgamation of vegetation communities into ‘vegetation mapping groups’. Vegetation mapping groups can include a number of very similar vegetation communities, or in the case of the ‘mixed riparian’ group, habitats with distinctly different vegetation communities which occur at such a small scale they cannot be mapped with API. These amalgamations were done to NVIS Level 3 (e.g. *Eucalyptus* open woodland) and where possible, to NVIS Level 4 — in which the dominant species was identified (e.g. *Eucalyptus tetrodonta* open woodland).

The digital vegetation dataset was updated with the survey data and boundaries amended where required. High spatial resolution 50 cm WorldView-2 satellite imagery from 2013 was utilised and vegetation polygon boundaries were subsequently realigned to the new imagery.

3.1.2 Vegetation Condition Assessment

The vegetation condition assessment was guided by a desktop review of the survey area’s disturbance history, examination of the field survey data and consultation with ERA staff. Separate condition assessments were made for terrestrial and riparian vegetation communities.

Terrestrial Assessment

The Vegetation Assets, States and Transitions (VAST) framework by Thackway and Lesslie (2005) was applied to assess the condition of terrestrial vegetation in the survey area (Table 3). The VAST classification orders vegetation by degree of modification and as a series of states from residual or baseline condition through to total removal, taking into account vegetation cover, structure, composition and regenerative capacity. This approach was considered most suitable for the assessment of vegetation condition in the survey area given previous mining and fire related impacts. It should be noted that as the VAST categories are broad there can be substantial variations of attributes within categories and that while the VAST framework takes into account the regenerative capacity of the vegetation community this is done within the limits of a one-off survey.

The identification of 'benchmarks' was mainly based on the condition of less disturbed areas within the survey area, as recommended by the NT draft guidelines (Brocklehurst and Price 2008). The vegetation communities that existed in the survey area prior to mining were also taken into consideration. Early land unit mapping suggests that prior to the mine's establishment the entire terrestrial survey area was dominated by *Eucalyptus* open forest communities or so-called savanna woodlands (Wells 1979). This mapping described the vegetation community as *Eucalyptus tetrodonta, E. miniata, E. bleeseri, E. porrecta* open forest with *Acacia* sp., *Livistona humilis* and *Gardenia megasperma* in the midstorey and *Sorghum* spp., *Themeda triandra* and *Eriachne triseta* grass in the understorey. However, the classification of the vegetation density as 'open forest' may not be the same as that currently applied in the NVIS (DoE 2013a).

The VAST framework does not take into account the suitability of the vegetation community as habitat for individual fauna species, which may have specific and varying preferences. (Fauna habitat values are addressed in section 5).

Riparian Assessment

An assessment of riparian vegetation condition was conducted according to the 'Tropical Rapid Appraisal of Riparian Condition Version 1 (for use in tropical savannas)' (TRARC, Dixon et al. 2006, personal communication Ian Dixon, ELA 20 November, 2013). An index of condition is derived from 24 indicators which are grouped into four sub-indices (plant cover, regeneration, weeds and erosion) and scored, with final ratings of poor to excellent (Table 4). An index of pressure is also derived from six indicators (bank stability, animals, fire, tree clearing, flow regime, anthropogenic alterations) which help identify the likely causes of change in condition.

Table 4: Indicators and ratings used to assess riparian condition in the survey area

	Vegetation Condition			**Pressure**	
Indicators	24 indicators under 4 sub-indices: Plant cover Regeneration Weeds Erosion			Bank stability Feral animals Fire Tree clearing Flow regimes Anthropogenic alterations	
Ratings	A	80 – 100	Excellent	High	50 – 100
	B	65 - 79	Good	Moderate	25 – 49
	C	50 - 64	Moderate	Low	0 - 24
	D	0 - 49	Poor		

Table 3: The Vegetation Assets, States and Transitions (VAST) vegetation condition classification

		Increasing vegetation modification from left to right →						
		Native Vegetation Cover Dominant structuring plant species indigenous to the locality and spontaneous in occurrence – i.e. a vegetation community described using definitive vegetation types relative to estimated pre-1750 types				**Non-Native Vegetation Cover** Dominant structuring plant species indigenous to the locality but cultivated, alien to locality and cultivated; or alien to the locality and spontaneous		
Vegetation Cover Classes		**Type 0: RESIDUAL BARE** areas where native vegetation does not naturally exist	**Type I: RESIDUAL** native vegetation community structure, composition and regenerative capacity intact – no significant perturbation from land use/land management practice	**Type II: MODIFIED** native vegetation community structure, composition and regenerative capacity intact/perturbed	**Type III: TRANSFORMED** native vegetation community structure, composition and regenerative capacity significantly altered by land use/land management practice	**Type IV: REPLACED – ADVENTIVE** Native vegetation replacement – species alien to locality and spontaneous in occurrence	**Type V: REPLACED – MANAGED** Native vegetation replaced with cultivated vegetation	**Type VI: REMOVED** Vegetation removal
Diagnostic Criteria	**Current regenerative capacity**	Natural regenerative capacity unmodified – ephemerals and lower plants	Natural regenerative capacity unmodified	Natural regeneration tolerates/endures under past &/ or current land management practices	Natural regeneration capacity limited/at risk under past &/or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice	Regeneration of native vegetation community has been suppressed by ongoing disturbances of the natural regenerative capacity. Limited potential for restoration	Regeneration of native vegetation community lost or suppressed by intensive land management. Limited potential for restoration	Nil or minimal

		Increasing vegetation modification from left to right						
		Native Vegetation Cover Dominant structuring plant species indigenous to the locality and spontaneous in occurrence – i.e. a vegetation community described using definitive vegetation types relative to estimated pre-1750 types				**Non-Native Vegetation Cover** Dominant structuring plant species indigenous to the locality but cultivated, alien to locality and cultivated; or alien to the locality and spontaneous		
	Vegetation structure	Nil to minimal	Structural integrity of native vegetation community if very high	Structure is predominantly altered but intact e.g. a layer/ strata and/or growth forms and/ or ages classes removed	Dominant structuring species of native vegetation community significantly altered e.g. a layer/strata frequently & repeatedly removed	Dominant structuring species of native vegetation community removed or predominantly cleared or extremely degraded	Dominant structure species of native vegetation community removed	Vegetation absent or ornamental
	Vegetation composition	Nil to minimal	Compositional integrity of native vegetation community is very high	Composition of native vegetation community is altered but intact	Dominant structuring species present – species dominance significantly altered	Dominant structuring species of native vegetation community removed	Dominant structuring species of native vegetation community removed	Vegetation absent or ornamental

3.2 RESULTS

Results of the vegetation community mapping and vegetation condition assessment are outlined below.

3.2.1 Vegetation Community Mapping

Thirty-three vegetation mapping groups were identified and mapped in the survey area (Figure 6, Appendix H). These included *Eriachne* grasslands, *Melaleuca* forest, *Eucalyptus* woodland and *Acacia* shrubland (Figures 7, 8, 9 and 10). Vegetation mapping groups were named after the dominant vegetation community, or in one case, given a habitat-related name and are described in more detail in Appendix I.

The total area mapped was 222 ha with the dominant vegetation mapping groups being:

- mixed riparian (52 ha)
- *Eucalyptus tetrodonta* open woodland (44 ha)
- *Melaleuca argentea* open woodland / woodland (creek bed vegetation) (23 ha).

The dominant vegetation mapping groups in the 12 ha proposed vent corridor were:

- cleared zones (5 ha)
- previously cleared land carrying various stages of regrowth (2 ha) (e.g. *Acacia* open shrublands, *Calytrix* open shrubland, grassland)
- *Eucalyptus tetrodonta* open woodland (2 ha)
- *Eucalyptus tetrodonta* woodland (1 ha)
- *Melaleuca viridiflora* open forest (0.4 ha).

Results of detailed vegetation surveys are provided in Appendix F, while a full species list is provided in Appendix J.

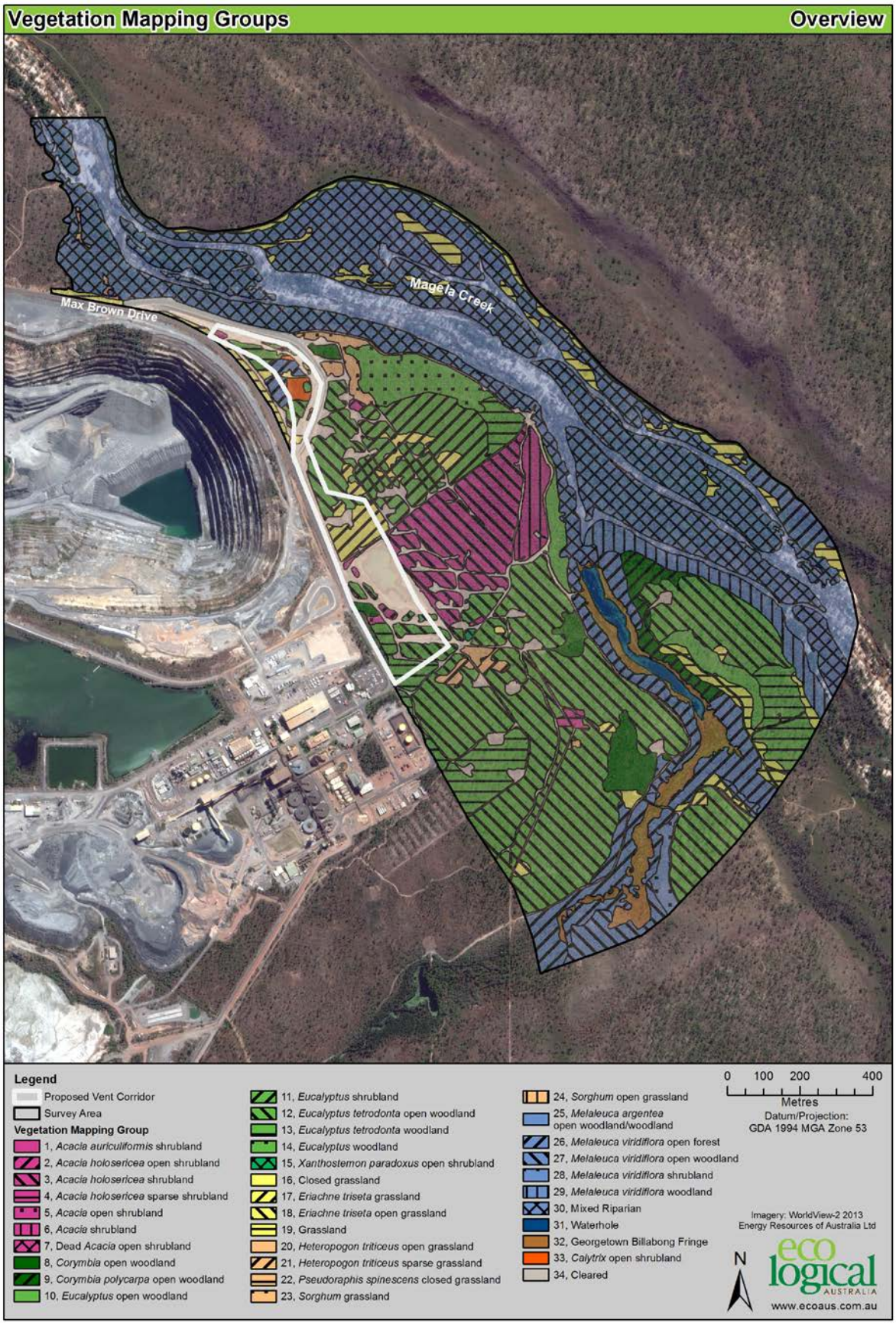

Figure 6: Broad vegetation mapping groups (Detailed descriptions provided in Appendix H)

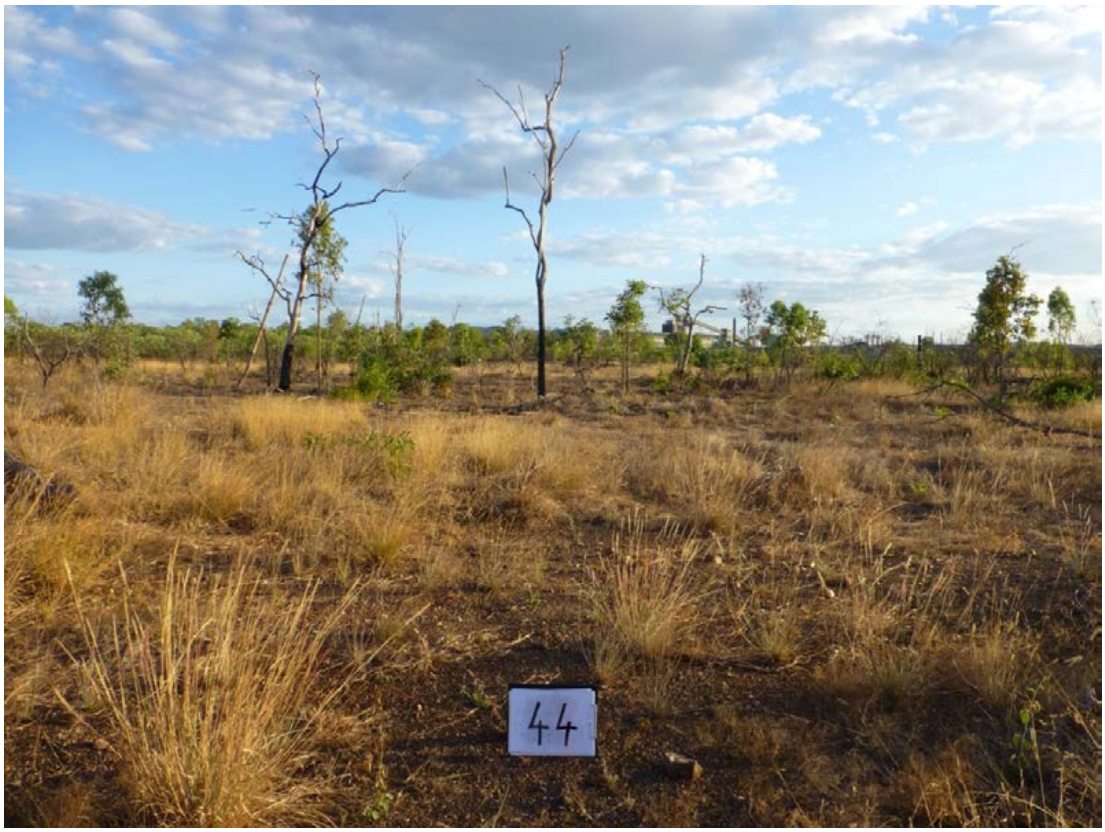

Figure 7: *Eriachne triseta* grassland (vegetation mapping group 17, site 44)

Figure 8: *Melaleuca viridiflora* open forest (vegetation mapping group 26, site 91-2)

Figure 9: *Eucalyptus tetrodonta* open woodland (vegetation mapping group 12, site 95)

Figure 10: *Acacia holosericea* shrubland (vegetation mapping group 3, site 82)

3.2.2 Vegetation Condition Assessment

Vegetation condition assessments for terrestrial and riparian areas are provided in light of the area's disturbance history. Impacts of this disturbance on the condition and character of specific vegetation communities is discussed, as well as the level of habitat fragmentation that has occurred as result of existing clearing.

Disturbance History

The survey area has been subject to significant disturbance ranging from mining related activities such as irrigation (or 'land application') and clearing, to naturally occurring events such as fire, flooding and storms / cyclones, and impacts due to feral pigs and weeds (Figure 11). Approximately 40 % of the terrestrial survey area has been impacted by some form of anthropogenic disturbance.

Irrigation (Land Application)

Approximately 20 % of the survey area and 61 % of the proposed vent corridor have been subject to irrigation. The dominant vegetation communities in the MLAA and MLAA Extension were:

- *Eucalyptus tetrodonta* open woodland (13 ha)
- cleared (8 ha)
- *Eucalyptus* shrubland (7 ha)
- *Acacia holosericea* shrubland (7 ha).

Clearing

Clearing associated with exploration and other mine-related activities was evident in terrestrial areas and covered 19 ha or 8 % of the survey area. This includes the proposed vent corridor which has 5 ha or 47 % of its total 12 ha area cleared (Figure 6). Depending on the final location of clearing within the proposed vent corridor (in respect of currently cleared and uncleared areas), the proposed clearing of 2 ha could bring the total cleared area in the survey area to a maximum of approximately 20 ha and in the vent corridor to a maximum of 7 ha.

Cleared areas occur predominantly in the central sections of the survey area and consist primarily of a network of tracks and drill pads for exploration, and a borrow pit in the southern part of the proposed vent corridor. This clearing has impacted the availability of habitat resources across the broader survey area and results in small-scale habitat fragmentation. No clearing was evident in the riparian vegetation communities (Figure 11).

Regrowth of various stages (ranging from *Sorghum* open grasslands, *Eucalyptus* shrublands, to *Acacia holosericea* shrublands—see Appendix I for detailed descriptions) was also recorded in older clearings or otherwise heavily impacted areas.

Fire

Addison (2011) reported an unusually hot, late dry season fire in 2008 which burnt most of the MLAA and MLAA Extension (Figure 12). It is likely that this hot fire affected the surrounding vegetation, particularly the understory.

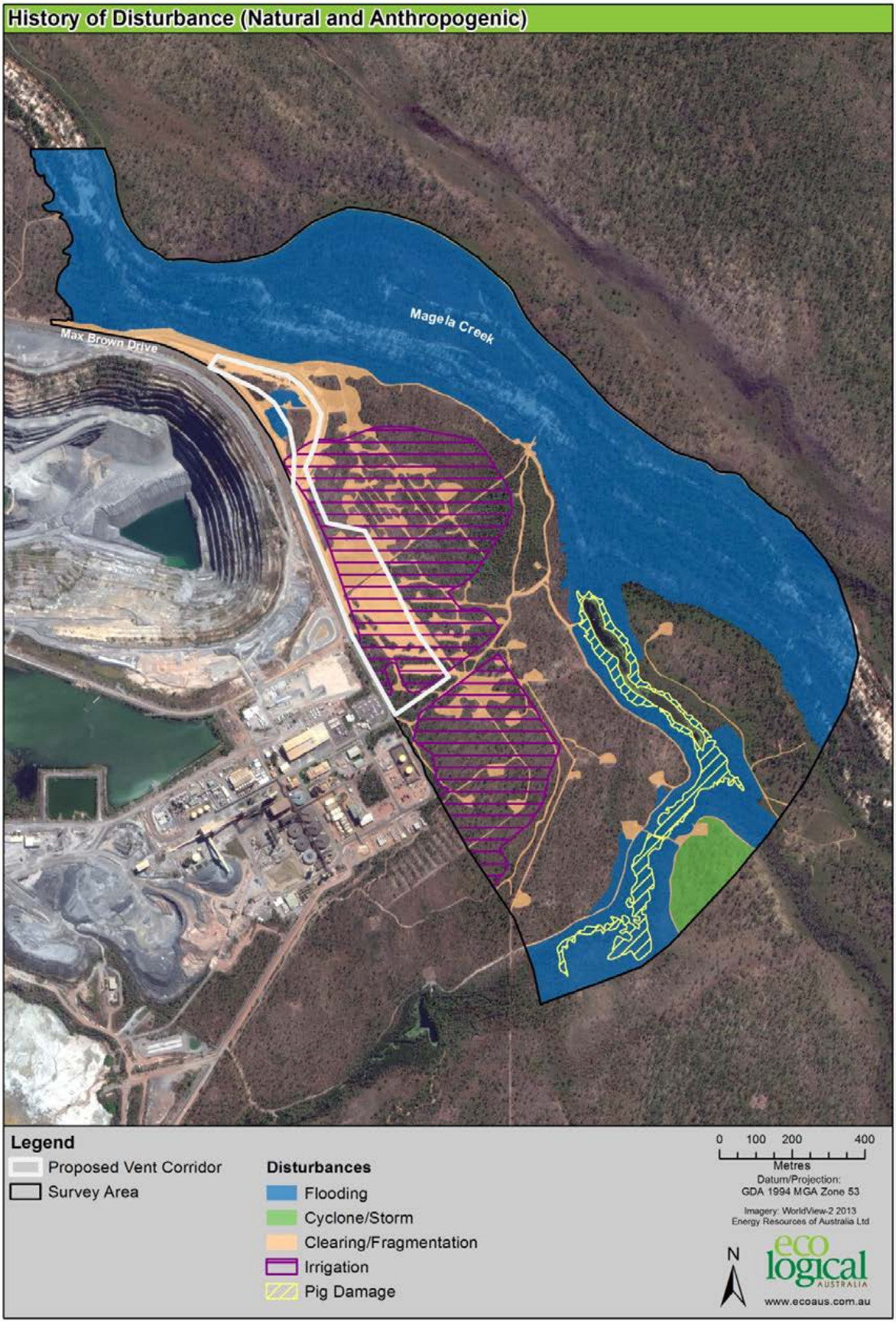

Figure 11: Overview of disturbance in the survey area

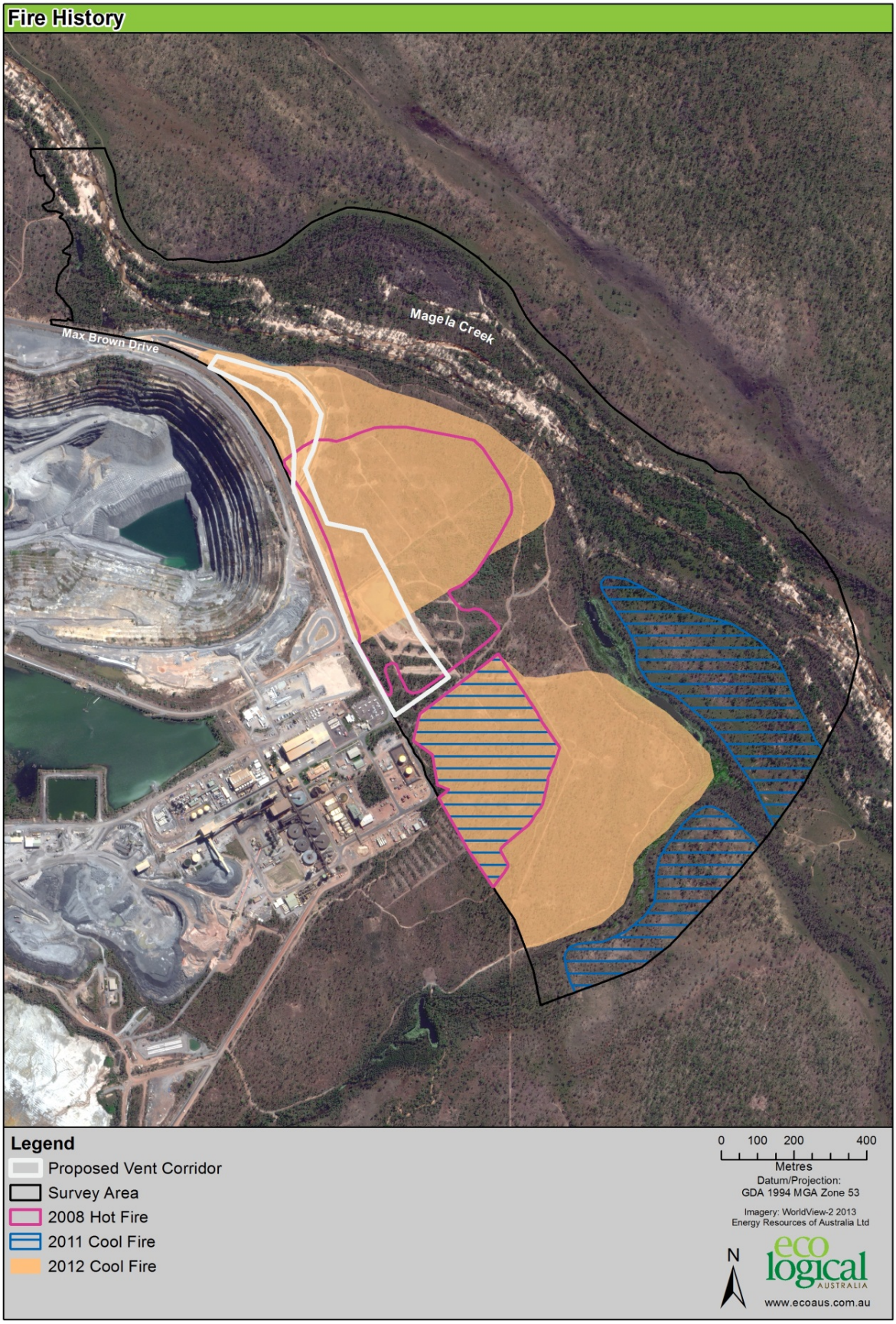

Figure 12: Fire history

Cool, early dry season fires occurred in the MLAA Extension in 2011 and 2012 with sections of the terrestrial open woodlands in the south-east of the survey area burnt in 2011. The north western section of MLAA was also burnt in 2012. The cool early dry season fires were lit by ERA as part of their fire management program (McIntyre 2011).

Flooding and Storms / Cyclones

A slightly elevated stand of a *Eucalyptus tetrodonta* open woodland in the south east of the survey area (Figure 11) showed evidence of storm damage which may have been caused by Cyclone Monica in 2006.

Seasonally high precipitation inundates the river systems and floodplains in the Top End during the wet season. The native flora is well adapted to these annual cycles of flooding and drought and responds accordingly. At the time of the survey (mid-late dry season) the river bed of the Magela Creek was mostly dry and only a small waterbody was left in Georgetown Billabong.

Feral Pigs and Cattle

Major pig damage was observed on the banks of Georgetown Billabong (Figure 11) and minor pig damage in other riparian areas of the survey area. There was also evidence of buffalo grazing in riparian *Eriachne triseta* grassland in the south west of the survey area, but no significant disturbance was evident.

Weeds

Minor occurrences of the introduced annual Mission Grass (*Cenchrus pedicellatum*) were recorded in the former MLAA and MLAA Extension during the survey. Four of the five patches were equal to or less than 1 m in diameter while one patch was 50 m in diameter. Minor occurrences of Passionfruit (*Passiflora foetida*) were also recorded in the area, but the exotic species is regarded as a naturalised vine (Weed Management Branch DLRM 2013).

It is noted that weed management had recently been undertaken in the area and that this one-off assessment should not be taken as a comprehensive assessment of all weeds that may be present in the survey area under different seasonal conditions.

Terrestrial Condition Assessment

Terrestrial native and non-native vegetation communities cover 113 ha or 51% of the total survey area. The condition of native vegetation communities varied from ‘residual’ to ‘transformed’ (Figure 13). Of the non-native vegetation cover, only one small area at the foot of the bund wall was rated as ‘replaced – adventive’, since mainly introduced grass species were found in this area. Cleared areas were rated as ‘removed’.

Most of the vegetation not affected by irrigation was rated as ‘residual’ with fire being the only disturbance. While some of these ‘residual’ areas form small patches within a larger fragmented

habitat (see section 3.2.2.4), they have still retained their community structure, composition and regenerative capacity.

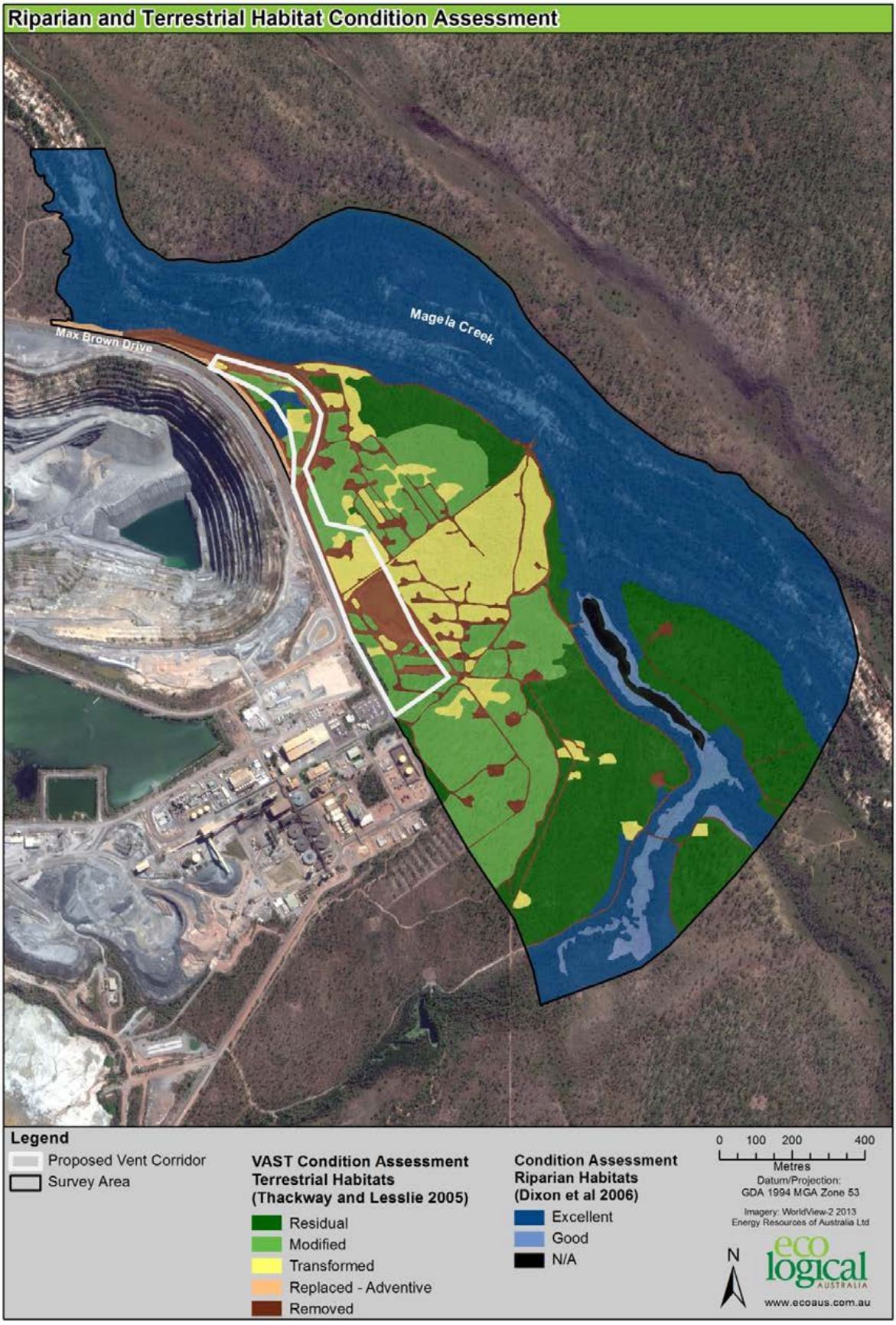

Figure 13: Riparian and terrestrial habitat condition assessment

Magela Land Application Area

Vegetation condition within the MLAA varied between 'modified' and 'transformed'. *Eucalyptus* shrublands and open woodlands were rated as 'modified', since their structure, composition and regenerative capacity was altered but still intact. All *Acacia* shrubland communities were rated as 'transformed', as their structure, composition and regenerative capacity was significantly altered and rehabilitation is possible through modified land management practices (e.g. fire). In addition, the land application areas (especially the northern MLAA) were impacted by habitat fragmentation through clearing (tracks, exploration drill pads and a borrow pit).

Proposed Vent Corridor

Vegetation condition in the proposed vent corridor ranged from 'modified' to 'transformed', with the cleared areas rated as 'removed'. The proposed vent corridor can be divided into a northern section (remnant surrounded by bund walls and mine access road) and a southern section (affected by land application). Vegetation condition in the latter is discussed above (Land Application Areas).

Within the small vegetation remnant in the northern section, the majority of vegetation consisted of regrowth. The regrowth vegetation communities were rated according to their structure, composition and regenerative capacity as 'modified' or 'transformed'.

A small remnant of the riparian vegetation community *Melaleuca viridiflora* open forest in the north of the proposed vent corridor was intact and therefore rated as 'excellent' using the TRARC methodology. The isolation of this remnant through bund walls has not appeared to impact on its condition.

Riparian Assessment

Riparian vegetation communities cover 109 ha or 49% of the survey area. Scores for the four sub-indices (see section 0) across these riparian areas were:

Plant cover	A	Excellent
Regeneration	B	Good
Erosion	A	Excellent
Weeds	A	Excellent
Pressure index		Low

The condition of these communities based on the TRARC methodology varies between 'good' and 'excellent'; with the majority of riparian areas rated as 'excellent'. Those areas rated as good have been downgraded from 'excellent' based on the damage by feral pigs.

Habitat Fragmentation

Vegetation communities within and adjacent to the vent corridor exist to a large degree as highly fragmented islands due to a network of tracks, drill pads and other cleared areas. While this fragmentation is small scale in terms of the extent of each cleared area and is potentially not a large hindrance for most animals, the number of clearings is high and the cumulative effect is therefore

likely to be substantial. Impacts on vegetation communities has included a general opening of the tree canopy, increased vulnerability to wind and severe weather events, increased vulnerability to weed invasion, decreased capability to capture and use resources (e.g. water, leaf litter for nutrient recycling) and increased fire risk due to an increase in groundcover/fuel loads. Further information on habitat values is provided in section 5.

3.2.3 Threatened Flora Species

The likelihood analysis (section 2) indicated that the presence of any threatened flora species within the survey area was unlikely and accordingly a targeted threatened species survey was considered unnecessary.

The flora data from the vegetation mapping field survey was reviewed however to assess the presence of any threatened species. Ninety-two flora species from 30 families were identified during the vegetation community surveys (Appendix J). None of these flora species are listed as threatened under the EPBC Act or TPWC Act, providing additional strength to the conclusion of the likelihood assessment.

3.3 CONCLUSION

Vegetation community mapping and an assessment of the condition of terrestrial and riparian vegetation was undertaken to contribute to an assessment of the environmental impact of the proposed action.

3.3.1 Vegetation mapping

Detailed and more general vegetation community surveys were undertaken to produce a vegetation map of the 222 ha survey area. Thirty-three vegetation mapping groups were identified ranging from open grasslands to *Eucalyptus* woodland. Dominant vegetation mapping groups were: mixed riparian; *Eucalyptus tetrodonta* open woodland; and *Melaleuca argentea* open woodland / woodland. Dominant vegetation mapping groups in the proposed 12 ha vent corridor included: cleared areas; regrowth areas; *Eucalyptus tetrodonta* open woodland and woodland, and *Melaleuca viridiflora* open forest. Ninety-two flora species from 30 families were identified; none of which are listed threatened species. Overall, the vegetation communities in the survey area are not uncommon, and are indicative of those that occur in surrounding KNP.

Whilst common drivers for vegetation community composition and structure in the Top End (such as soils and position in the landscape) played minor roles within the survey area, disturbances such as irrigation, managed fire regime and land clearing has strongly modified the original *Eucalyptus* open forest vegetation community.

3.3.2 Vegetation condition

Vegetation condition was assessed to take into account past and present land use, disturbances and land management, hence providing an overview of the cumulative effects of these impacts on both terrestrial and riparian vegetation communities. The survey area has been subject to significant disturbance ranging from mining related activities, such as irrigation and clearing, to naturally occurring events such as fire, flooding, storms / cyclones and impacts due to feral pigs and weeds.

Clearing for a range of purposes has meant that vegetation communities within and adjacent to the vent corridor exist to a large degree as highly fragmented islands. While this fragmentation is small scale in terms of the extent of each cleared area and is potentially not a large hindrance for most animals, the number of clearings is high and the cumulative effect on fauna habitat is therefore likely to be substantial. Further information on fauna habitat values is provided in section 5.

Terrestrial native and non-native vegetation communities cover just over half of the total survey area, of which approximately 40 % has been impacted by some form of disturbance. The VAST framework (Thackway and Lesslie 2005) was used to classify the condition of terrestrial vegetation according to degree of modification and as a series of states from residual or baseline condition (representing native vegetation in least modified condition) through to total removal, taking into account vegetation cover, structure, composition and regenerative capacity.

Much of the wider survey area not affected by irrigation supports terrestrial vegetation subject to minimal modification (residual) with fire being the only disturbance. These areas are entirely outside of the proposed vent corridor and would not be disturbed during construction activities. The proposed vent corridor supports modified or substantially transformed native vegetation; non-native vegetation; or is completely cleared.

Riparian vegetation communities (vegetation map units 19, 22 and 25 to 30) cover 49% of the survey area. Their condition was assessed according to the 'Tropical Rapid Appraisal of Riparian Condition' methodology (Dixon et al. 2006) and varied between 'good' and 'excellent'; with the majority rated as 'excellent'. Those areas rated as good had been damaged by feral pig activity.

Riparian vegetation communities in excellent and good condition occur almost entirely outside of the proposed vent corridor and would not be disturbed during construction activities. A small remnant of the riparian vegetation community *Melaleuca viridiflora* open forest in the north of the proposed vent corridor was intact and therefore rated as 'excellent'. The isolation of this remnant through bund walls has not appeared to impact on its condition. This small area may be disturbed either directly or indirectly by construction activities, depending on the final location of infrastructure.

Clearing for the proposed ventilation corridor would take place in vegetation communities already highly impacted by past land use and management. Cumulative effects from this additional clearing are unlikely due to the small scale of the proposed clearing. Overall, the additional potential impact of the proposed clearing on vegetation communities within the vent corridor and survey area is considered to be minor. Future land management, in particular weed and fire management, is likely to have a more significant impact on vegetation condition.

Significant potential downstream impacts from clearing, including those on drainage lines, watercourses, wetlands, and sensitive or significant vegetation communities (including nearby sections of Magela Creek, Georgetown Billabong and all associated riparian habitats) are considered to be unlikely due to the small scale of the proposed development and the distance of the clearing from the creek. Significant impacts from clearing at a more regional scale, across the Alligator Rivers Region and KNP are also considered to be unlikely.

4 THREATENED AND MIGRATORY FAUNA SPECIES SURVEY

4.1 METHODS

The survey was conducted over eight days between 4 and 11 September 2013 by ELA ecologists Robert Browne-Cooper, Sarah Dalgleish, Ian Dixon, Ranid May, Sarah Smith and Anja Zimmerman. The survey was conducted under a Northern Territory Parks and Wildlife Commission 'Permit to take wildlife for commercial purposes' (number 48035). The survey employed a combination of techniques to detect target species including:

- Elliott, cage and funnel traps
- bird censuses including specific wetland birds
- call playback for Masked Owl
- acoustic recording for bats
- nocturnal and diurnal active searches
- remote cameras
- hair tubes
- flushing and area surveys.

4.1.1 Selection of Survey Sites

Survey sites represented a range of habitats within the proposed vent corridor and the surrounding vegetation including Eucalyptus woodland, riparian woodland and Magela Creek / Georgetown Billabong. The selection of the survey sites was a three step process. Firstly, a desktop review of draft vegetation mapping was used to identify major vegetation types within the survey area. Secondly, field reconnaissance was undertaken to select specific sites, and thirdly, discussions with ERA staff were undertaken during the site reconnaissance stage to avoid culturally sensitive areas. Survey effort at each site is presented at Table 5.

4.1.2 Trapping Surveys

Trapping was undertaken at six sites (Transects A – F, Figure 14). At each site, a transect was established comprising:

- 20 type A Elliott traps spaced at approximately 10 m intervals
- five type B Elliott traps mounted 1.5 – 1.8 m above the ground on suitable large trees
- four treadle activated wire cage traps (500 mm x 250 mm x 250 mm)
- 10 funnel traps distributed in pairs along a 30 m drift fence (Figure 15).

Traps were operated for four nights, and checked daily within two hours of dawn to avoid exposing captured animals to heat stress. All traps were closed when checked in the morning and re-opened each evening to prevent inadvertent trapping of animals. Elliott and cage traps were baited with universal bait (a combination of oats, peanut butter and honey at a ratio of 3:3:1), while funnel traps were not baited. Bait was replaced as required (e.g. when the baits were too dry or attracted ants).

Table 5: Details of survey sites and survey effort

Site	Vegetation	Survey effort
Sites in or adjacent to vent corridor		
Transect A	Adjacent to proposed vent corridor - *Sorghum* grassland, *Corymbia* open woodland, *Eucalyptus tetrodonta* open woodland	Elliott, cage and funnel traps, 4 nights Bird observations (overlaps nocturnal survey 6)
Transect D	Within vent proposed corridor - *Eucalyptus tetrodonta* open woodland / woodland, *Acacia* open shrubland, *Corymbia* open woodland	Elliott, cage and funnel traps, 4 nights Bird observations (overlaps nocturnal survey 5 and transect L)
Transect K	Within proposed vent corridor - *Eucalyptus* open woodland / woodland, *Melaleuca viridiflora* open forest, *Melaleuca viridiflora* woodland – riparian, *Calytrix* open shrubland	5 remote cameras, 10 hair tubes 39 nights (overlaps nocturnal survey 7)
Transect L	Within proposed vent corridor - *Eucalyptus tetrodonta* woodland, *Acacia* open shrubland, *Corymbia* open woodland	5 remote cameras, 10 hair tubes 38 nights
Nocturnal survey 5	Within / adjacent to vent corridor -*Eucalyptus tetrodonta* open woodland / woodland	3 people, 30 minutes
Nocturnal survey 6	Adjacent to proposed vent corridor -*Corymbia* open woodland, *Eucalyptus tetrodonta* open woodland, *Sorghum* grassland	3 people, 30 minutes Masked Owl playback
Nocturnal survey 7	Within proposed vent corridor - *Eucalyptus tetrodonta* open woodland / woodland, *Melaleuca viridiflora* open forest – riparian, *Calytrix* open shrubland, *Melaleuca viridiflora* open forest	2 people, 30 minutes
Woodland sites		
Transect B	*Eucalyptus tetrodonta* woodland	Elliott, cage and funnel traps, 4 nights Bird observations
Transect E	*Eucalyptus tetrodonta* woodland	Elliott, cage and funnel traps, 4 nights Bird observations
Transect H	*Acacia holosericea* open shrubland / shrubland	5 remote cameras, 10 hair tubes 39 nights

Site	Vegetation	Survey effort
Transect I	*Corymbia* open woodland, *Eucalyptus tetrodonta* open woodland	5 remote cameras, 10 hair tubes 39 nights
Song meter 2	*Eucalyptus tetrodonta* open woodland	1 song meter, 2 nights
Nocturnal survey 4	*Corymbia* open woodland, *Eucalyptus tetrodonta* woodland	1 person, 25 minutes
Nocturnal survey 8	*Eucalyptus tetrodonta* open woodland	3 people, 30 minutes Masked Owl playback
Nocturnal survey 9	*Eucalyptus tetrodonta* open woodland, *Eriachne triseta* open woodland	3 people, 30 minutes Masked Owl playback
Riparian sites		
Transect C	Mixed riparian anabranch, *Melaleuca argentea* mid woodland / open forest, creek bed	Elliott, cage and funnel traps, 4 nights Bird observations
Transect F	*Melaleuca viridiflora* woodland – riparian, *Melaleuca argentea* mid woodland / open forest, creek bed	Elliott, cage and funnel traps, 4 nights Bird observations
Transect G	Mixed riparian – anabranch	5 remote cameras, 10 hair tubes 39 nights
Transect J	*Melaleuca viridiflora* woodland - riparian	5 remote cameras, 10 hair tubes 38 nights
Song meter 3	*Melaleuca viridiflora* open forest	1 song meter, 2 nights
Nocturnal survey 1	Mixed riparian anabranch	4 people, 30 minutes
Nocturnal survey 2	Mixed riparian anabranch, *Melaleuca argentea* mid woodland / open forest, creek bed	4 people, 30 minutes Masked owl playback
Diurnal survey 1	Mixed riparian anabranch, *Melaleuca argentea* mid woodland / open forest, creek bed	3 people, 1 hour

Site	Vegetation	Survey effort
Diurnal survey 2	Mixed riparian anabranch, *Melaleuca argentea* mid woodland / open forest, P*seudoraphis spinescens* closed grassland	3 people, 1 hour
Wetlands		
Song meter 1	Billabong edge - closed grassland	1 song meter, 2 nights
Nocturnal survey 3	Billabong edge - closed grassland, *Melaleuca viridiflora* open forest, mixed riparian, transition zone riparian - woodland	3 people, 1.75 hours 3 people, 1 hour Masked owl playback
Dawn wetland bird census 1	Georgetown Billabong	2 people, 2 hours 2 people, 1.5 hours 2 people, 20 minutes 2 people, 1 hour, 10 minutes
Dawn wetland bird census 2	Retention Pond 1	2 people, 1 hour 40 minutes
Dawn bird census	Various waterholes in dry creekbed	6 people, one hour
Dusk wetland bird census	Georgetown Billabong	2 people, 1 hour 2 people, 1 hour 15 minutes 2 people, 35 minutes

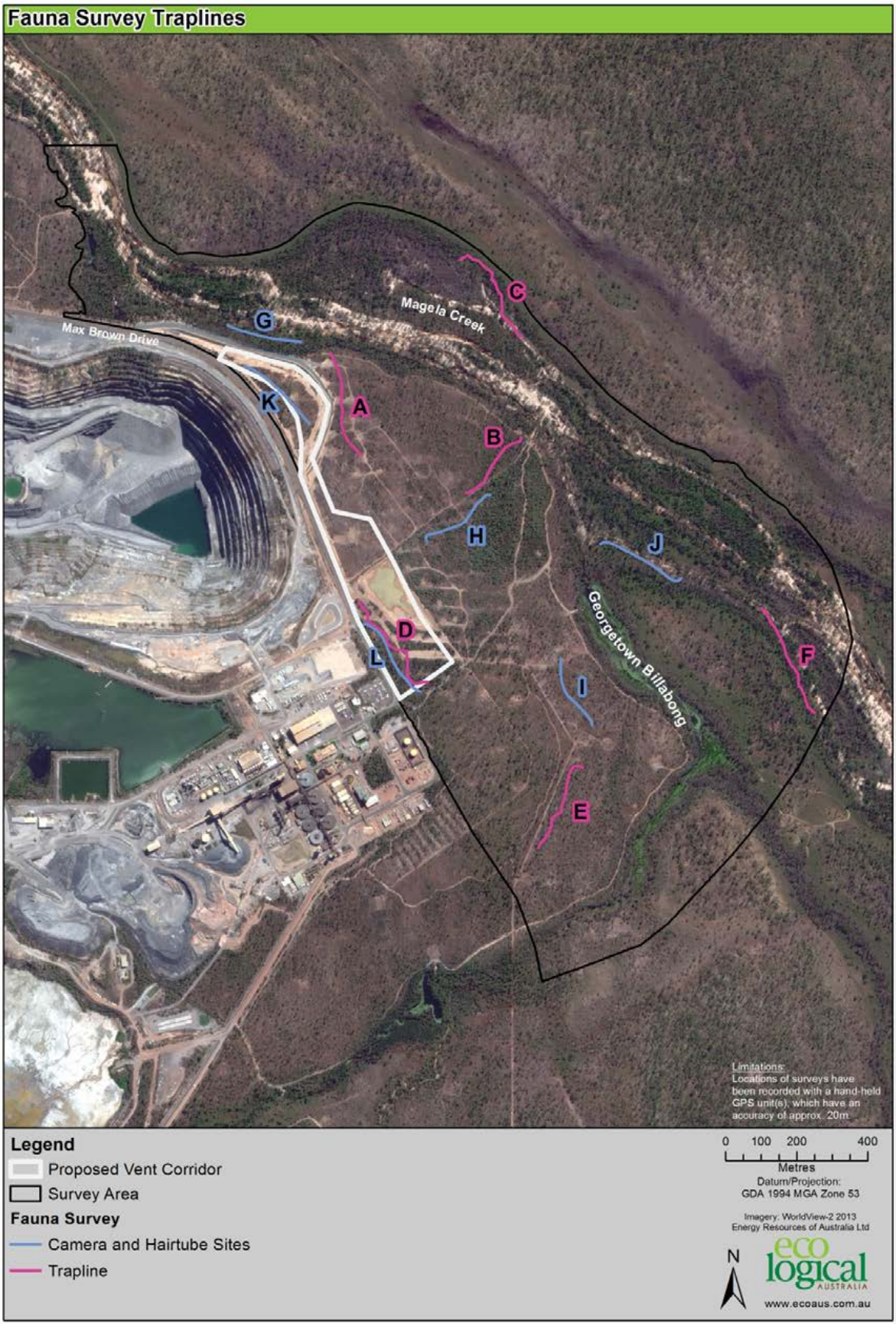

Figure 14: Fauna survey traplines

Figure 15: Drift fence with paired funnel traps

4.1.3 Bird Census

All birds observed or heard while working around the survey area were recorded, which included the time during installation of traplines and cameras and nocturnal surveys. In addition, between 6 and 10 September bird surveys were conducted at each transect while checking traps at dawn.

4.1.4 Wetland Bird Census

Dawn wetland bird censuses were conducted at Georgetown Billabong between 8 and 11 September and dusk censuses were conducted 8 to 10 September (Figure 16). A dawn census was conducted at RP1 on 10 September. Each census was conducted by two observers with binoculars (8.5 x 45 mm) and a spotting scope (20 to 60 times magnification) mounted on a tripod. All birds observed or identified from calls within the wetland and the fringing riparian forest were recorded. The dawn censuses commenced at 6.15 am and continued for between 20 minutes and two hours until all bird species in the area had been identified and recorded. Dusk censuses commenced at 5.45 pm and lasted between 35 and 75 minutes.

Figure 16: Waterbird census sites

4.1.5 Nocturnal and Diurnal Active Searches

Nine nocturnal searches were conducted between 5 and 10 September (Figure 17). During each search, one to four people searched with high-powered head or handheld torches. Searches lasted for between 25 minutes and 105 minutes. Two diurnal searches were conducted by three people for one hour. These searches included recording birds observed and heard, raking through leaf litter, peeling back loose bark and lifting logs and rocks.

4.1.6 Call Playback

Call playback for Northern Masked Owls was conducted in conjunction with one nocturnal active search per night for five nights. Masked Owl calls were played through car speakers for two minutes, followed by five minutes of listening for a response (either through call or sighting); this procedure was repeated three times (21 minutes in total for each session).

4.1.7 Acoustic Recording

A Wildlife Acoustics SM2BAT+ bat detector was deployed at three sites for two nights each. Data were recorded in full spectrum lossless WAC0 format (384 kHz sampling rate; trigger 6 dB above background; 48 dB gain; set to turn on automatically at sunset and off at sunrise). The recorded data was provided to Specialised Zoological (Adelaide) who identified the bat species. Analysis data were converted to WAV format using Kaleidoscope 1.1.15 software. The software SCAN'R version 1.7.5 (Binary Acoustic Technology) was then used to exclude WAV files that did not potentially contain bat calls (identified on the basis of characteristic frequency, pulse shape, and the pattern of harmonics). The remaining WAV files were then opened and inspected in Adobe Audition CS6 5.0.2 software. Species were identified based on information in Milne (2002), and nomenclature follows Armstrong and Reardon (2006) and Appleton (2008) for *Miniopterus*.

4.1.8 Remote Cameras

A total of 30 motion-activated cameras were deployed around the survey area, including 10 white flash Reconyx HC550, eight covert Reconyx 600 and 12 semi-covert Reconyx 550. Five cameras were placed 50 m apart in six transects (transects G – L, Figure 14). Cameras were mounted on large trees approximately 60 cm above the ground and each camera was aimed at a baited hair tube (Figure 18). Where necessary, vegetation was cleared to avoid accidental triggering of motion sensors.

4.1.9 Hair Tubes

A total of 60 x 90 mm diameter hair tubes were deployed in conjunction with camera transects (transects G – L, Figure 14). Two hair tubes were placed with each camera (50 m apart). Hair tubes were secured to the ground by either a heavy object (e.g. log) or with plastic cable ties attached to a tent peg hammered into the ground. Hair tubes were baited with universal bait and hair samples were later identified by Barbara Triggs (Dead Finish, Genoa Victoria).

4.1.10 Area Searches, Flushing Survey and Incidental Observations

Flushing surveys and searches for habitat, signs of activity and predator scats were undertaken by the flora and fauna teams while traversing and working on the site. Signs of animal activity including tracks and diggings that could be associated with particular species were also recorded. Any fauna observed while travelling between sites was recorded as incidental observations or opportunistic sightings.

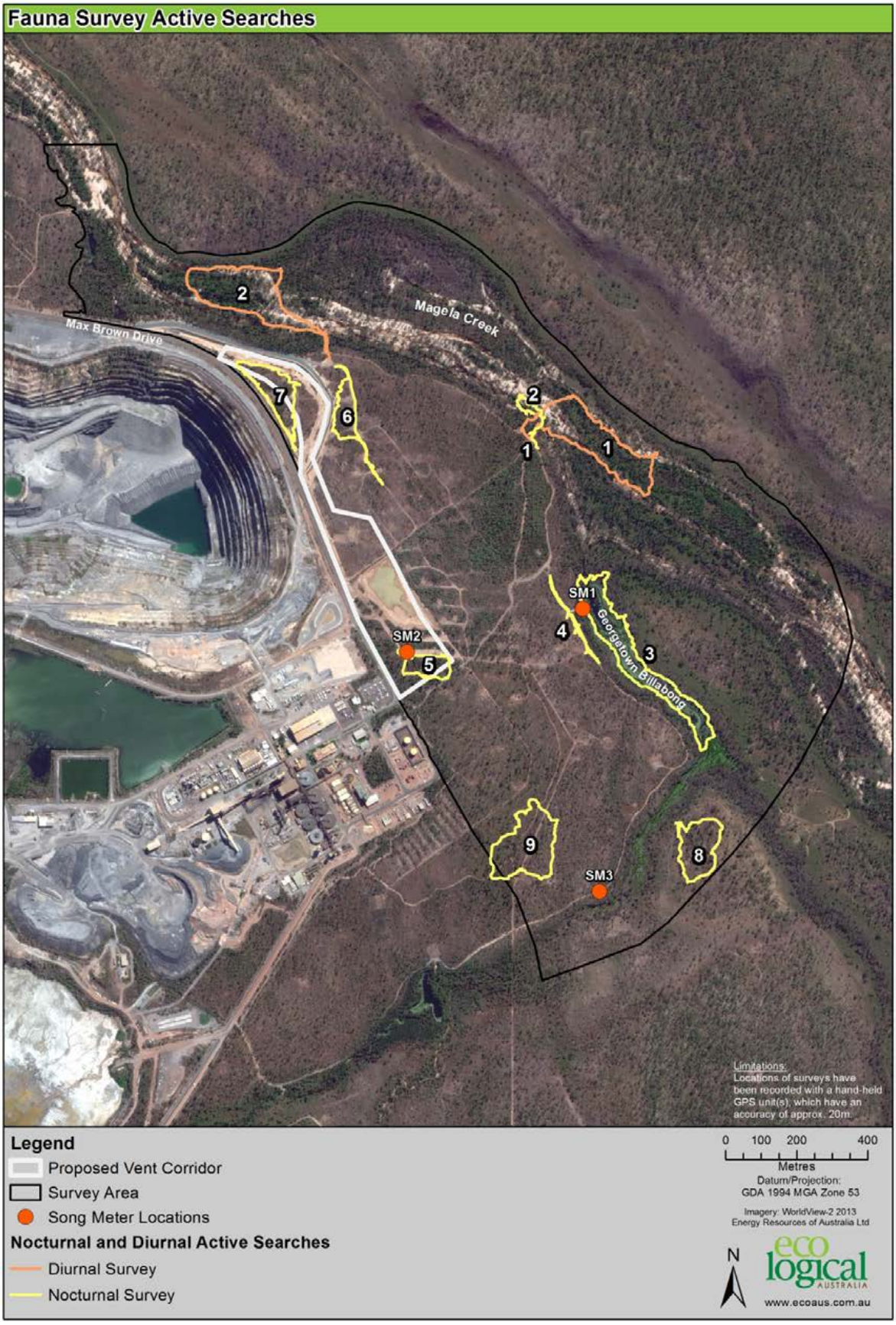

Figure 17: Fauna survey active search sites

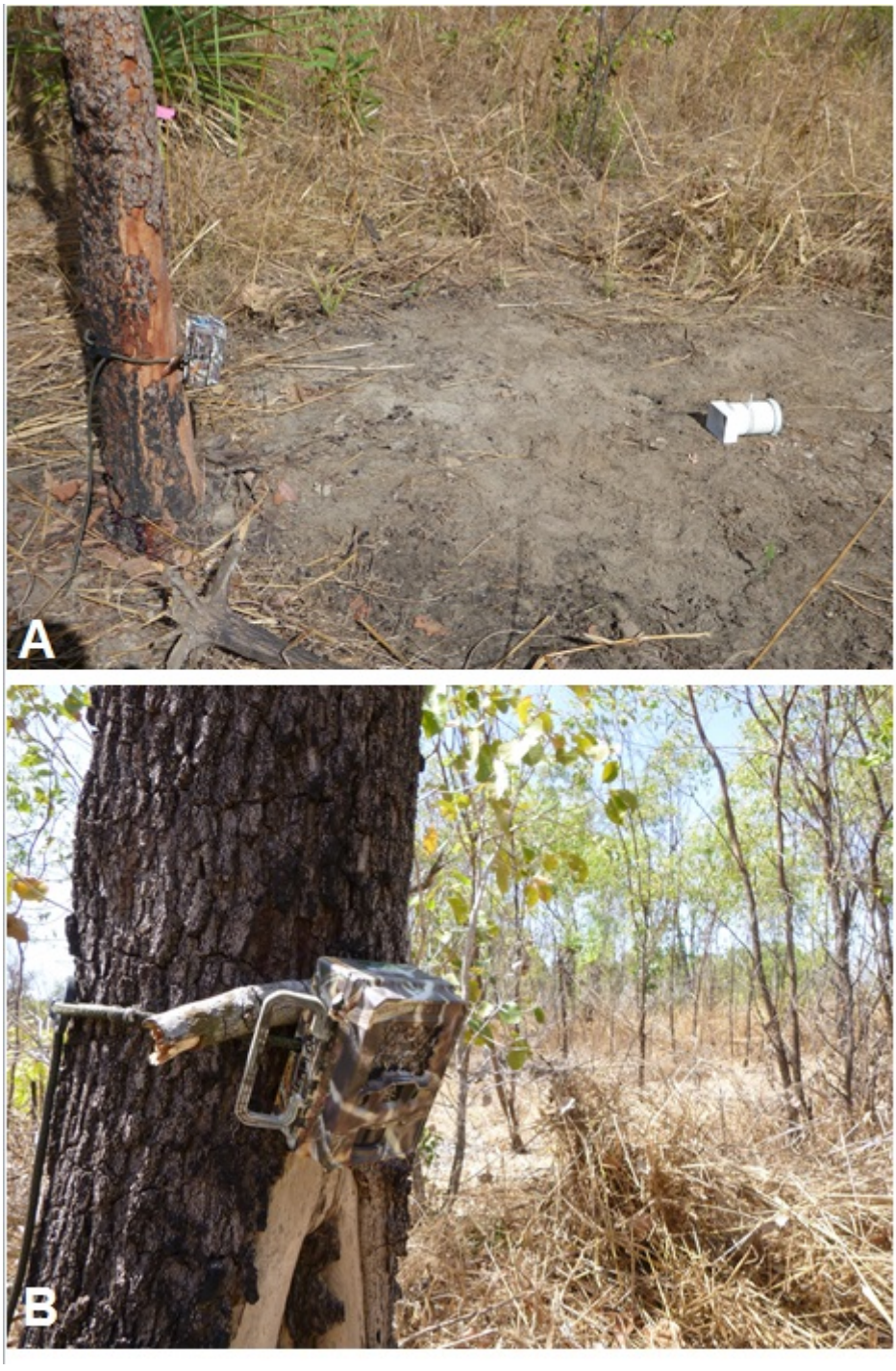

Figure 18: Remote camera A) aimed at a hair tube in a clearing, B) mounted on a tree

4.1.11 Compliance with EPBC Survey Guidelines

The DoE guidelines for survey of Australia's threatened fauna (DEWHA 2008 and 2010, and SEWPaC 2011 for mammals, birds and reptiles, respectively) were incorporated into the survey design (Table 6). Methods recommended for species that were more likely to occur, or more likely to be impacted by the project, were prioritised; while the total effort was enhanced by prolonged use of camera traps which remained on site for almost 40 nights. Area and flushing surveys and searches for habitat, signs of activity and predator scats were undertaken by the flora and fauna teams while traversing and working on the site.

Table 6: EPBC survey guidelines for threatened species, and the survey methods used

Species	EPBC guidelines		Methodology
	Method	Effort	
Bird species			
Eastern Partridge Pigeon *Geophaps smithii smithii*	Area searches or transect surveys	20 hours over five days per 50 ha	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Flushing surveys	15 hours over five days	Conducted while driving the site over 7 days
	Searches targeting waterholes in suitable habitat during dry season.	20 hours over 10 days	Dawn bird census at Georgetown Billabong – 10 person hours over 4 days Dawn bird census within Magela Creek – 6 person hours on 1 day
Gouldian Finch *Erythrura gouldiae*	Target searches and watches at waterholes late in the dry	12 hours over four days	Dawn bird census at Georgetown Billabong – 10 person hours over 4 days Dawn bird census within Magela Creek – 6 person hours on one day
	Area searches	20 hours over five days per 50 ha	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
Northern Masked Owl *Tyto novaehollandiae kimberli*	Nocturnal playback surveys in suitable habitat	8 hours over 4 days	1 hour, 45 minutes over 5 days
Red Goshawk *Erythrotriorchis radiatus*	Area searches for characteristic nests	80 hours over 10 days	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys

Species	EPBC guidelines		Methodology
	Method	Effort	
Yellow Chat *Epthianura crocea tunneyi*	Area searches	12 hours over 4 days	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Transect-point surveys	10 hours over 3 days	Method not used
Mammal species			
Arnhem Land Rock-rat *Zyzomys maini*	Daytime searches for potentially suitable habitat resources and signs of activity	Two hours for every 1 ha stratified survey site within the area	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Collection of predator scats, owl casts or remains in predatory bird / mammal nests / dens	Searches undertaken concurrently with habitat and activity searches	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Cage and Elliott trapping programs	Ten cage traps oriented in two parallel lines of five traps, spaced at 50 m intervals. Cages set for four consecutive nights 20 Elliott A traps oriented in two parallel lines of ten traps, spaced at 10 m intervals. Distance between the two parallel lines is 25 m. Traps set for four consecutive nights	24 cage traps, distributed among 6 transects, spaced at 50 m intervals. Cages set for four consecutive nights 120 Elliott A traps distributed along 6 traplines, spaced at 10 m intervals. Traps set for four consecutive nights
	Baited camera traps	Cameras should be deployed for at least 14 nights, approximately 10 cameras should be deployed per hectare	Cameras were deployed for 38 or 39 nights. 30 cameras were deployed over 220 ha (approximately 1 per 7 ha)
Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus nudicluniatus*	Mistnets	16 mist-net nights over a minimum of 4 nights	Method not used

Species	EPBC guidelines		Methodology
	Method	Effort	
	Unattended bat detectors	16 bat detector nights, over a minimum of 4 nights	6 bat detector nights over 6 nights
	Tree roost survey / inspection	1-2 hours per survey day	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
Brush-tailed Rabbit-rat *Conilurus penicillatus*	Daytime searches for potentially suitable habitat resources	Two hours for every 1 ha stratified survey site within the area (for a 5 ha site)	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Cage and Elliott trapping programs	Ten cage traps oriented in two parallel lines of five traps, spaced at 50 m intervals. Cages set for four consecutive nights 20 Elliott A traps oriented in two parallel lines of ten traps, spaced at 10 m intervals. Distance between the two parallel lines is 25 m. Traps set for four consecutive nights	24 cage traps, distributed among 6 transects, spaced at 50 m intervals. Cages set for four consecutive nights 120 Elliott A traps distributed along 6 traplines, spaced at 10 m intervals. Traps set for four consecutive nights.
	Spotlight surveys	Two 200 m transects per 5 ha site	Spotlight surveys were conducted at 9 sites averaging 400 m each
Golden-backed Tree-rat *Mesembriomys macrurus*	Daytime searches for potentially suitable habitat resources	Two hours for every 1 ha stratified survey site within the area (for a 5 ha site)	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Stagwatching surveys at potential nest sites	Commence survey 30 minutes before dusk and continue 60 minutes after sunset	Method not used
	Spotlight surveys	Two 200 m transects per 5 ha site	Spotlight surveys were conducted at 9 sites averaging 400 m each

Species	EPBC guidelines		Methodology
	Method	Effort	
	Combined arboreal and ground-based Elliott B and cage trapping surveys	Five tree mounted Elliott traps and five cage traps per site, for four nights	24 cage traps, distributed among 6 transects, spaced at 50 m intervals. Cages set for four consecutive nights 30 arboreal Elliott B traps were distributed among 6 transects spaced at 50 m intervals. Traps were set for four consecutive nights
	Camera traps	Cameras should be deployed for at least 14 nights, approximately 10 cameras should be deployed per hectare	Cameras were deployed for 38 or 39 nights. 30 cameras were deployed over 220 ha (approximately 1 per 7 ha)
Golden Bandicoot Isoodon auratus auratus	Daytime searches for suitable habitat, and signs of activity	Two hours for every 1 ha stratified survey site within the area (for a 5 ha site)	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Collection and analysis of predator scats	Two hours for every 1ha stratified survey site within the area (for a 5 ha site)	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys
	Soil plot survey	Two hours for every 1 ha stratified survey site within the area (for a 5 ha site)	Method not used
	Spotlight survey	Two 200 m transects per 5 ha site	Spotlight surveys were conducted at 9 sites averaging 400 m each
	Remote cameras	Approximately 10 cameras per ha, set for at least 14 nights.	Cameras were deployed for 38 or 39 nights. 30 cameras were deployed over 220 ha (approximately 1 per 7 ha)
Northern Brush-tailed Phascogale *Phascogale pirata*	Daytime searches for potential nest sites and signs of activity	Two hours for every 1 ha stratified survey site within the area (for a 5 ha site)	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys

Species	EPBC guidelines		Methodology
	Method	Effort	
	Stagwatching surveys	Commence survey 30 minutes before dusk and continue 60 minutes after sunset.	Method not used
	Spotlight survey	Two 200 m transects per 5 ha site	Spotlight surveys were conducted at 9 sites averaging 400 m each
	Hair sampling	For a site up to 5 ha, at least three sites should be used with 20 devices per site open for 14 consecutive nights.	Six sites were used with 10 hair tubes per site. Hair tubes were open for 38 or 39 nights
	Arboreal trapping – Elliott B traps	10 Elliott B traps oriented in two parallel lines of five traps, erected 2-4 m above the ground on a secure platform, and spaced at 50 m intervals. Traps set for four consecutive nights	30 arboreal Elliott B traps were distributed among 6 transects, spaced at 50 m intervals. Traps were set for four consecutive nights
	Remote cameras	10 cameras per hectare, set for at least 14 nights.	Cameras were deployed for 38 or 39 nights. 30 cameras were deployed over 220 ha (approximately 1 per 7 ha)
	Consultation	Consult with communities to locate the species	ERA employees were consulted
Northern Quoll Dasyurus hallucatus	Cage trapping, Elliott trapping	Three nights (minimum of four cage traps)	24 cage traps, distributed among 6 transects, spaced at 50 m intervals. Cages set for four consecutive nights 120 Elliott A traps distributed along 6 traplines, spaced at 10 m intervals. Traps set for four consecutive nights.
	Additional or complementary techniques:		
	Daytime searches for suitable habitat resources, latrines and tracks. Sand traps.	Two hours for every 1 ha stratified survey site within the area (for a 5 ha site)	Conducted while installing trap and camera transects, in conjunction with diurnal searches and during vegetation surveys

Species	EPBC guidelines		Methodology
	Method	Effort	
	Spotlight surveys	Two 200 m transects per 5 ha site	Spotlight surveys were conducted at 9 sites averaging 400 m each
	Remote cameras	Approximately 10 cameras per hectare, set for at least 14 nights.	Cameras were deployed for 38 or 39 nights. 30 cameras were deployed over 220 ha (approximately 1 per 7 ha)
	Hair tubes	For a site up to 5 ha, at least three sites should be used with 20 devices per site open for 14 consecutive nights.	Six sites were used with 10 hair tubes per site. Hair tubes were open for 38 or 39 nights
	Consultation	Consult with communities to locate the species	ERA employees were consulted
Reptile Species			
Arnhem Land Skink / Egernia *Bellatorias obiri*	Mammal cage or Elliott traps	No recommendation	24 cage traps, distributed among 6 transects, spaced at 50 m intervals. Cages set for four consecutive nights 120 Elliott A traps distributed along 6 traplines, spaced at 10 m intervals. Traps set for four consecutive nights.
	Late afternoon searches for sheltering individuals	No recommendation	Method not used
Plains Death Adder *Acanthophis hawkei*	There are no EPBC guidelines for surveying for this species, however the listing advice for the species (SEWPaC 2012) suggests that the only reliable way of detecting individuals is to drive slowly on roads that cross or run close to suitable habitat.	Evidence suggests that detection rates can be as low as one individual per 30-60 hours of surveying.	No suitable habitat exists within the survey area

4.2 RESULTS

A total of (at least) 125 species were recorded (the number of bat species is a minimum number, see section 4.1.7), comprising eight native amphibian species, 79 bird species, at least 17 native mammal species, 20 reptile species and three introduced species (Table 7). (Full details are given at Appendix K).

Table 7: Species recorded by each survey method within the survey area

Survey method / location	Amphibians	Birds	Mammals	Reptiles	Introduced
Trapping - including bird and nocturnal surveys at transects	0	33	3	13	0
Wetland bird survey and nocturnal survey at billabong	0	60	3	0	1
Nocturnal survey (independent of other sites)	6	2	0	6	1
Diurnal survey	2	17	0	1	2
Acoustic analysis	0	0	9*	0	0
Camera	0	9	5	2	3
Hair tube	0	0	1	0	0
Incidental / other surveys	5	31	2	4	2

* At least 9 species of bat were identified from acoustic recording

4.2.1 Trapping Surveys

Over four nights of trapping at six sites, 16 vertebrate species were trapped, including a female Fawn Antechinus (*Antechinus bellus*) which is listed as Endangered under the TPWC Act (Figure 19).

4.2.2 Wetland Bird Census

Bird observations at Georgetown Billabong recorded two native amphibians, 57 bird species, two native mammal species (including one bat), six reptiles and the introduced cane toad (*Rhinella marina*) in the billabong and fringing vegetation. A breeding pair of listed migratory White-bellied Sea-eagles (*Haliaeetus leucogaster*) was observed during most surveys in the area (Figure 20). One dawn survey of RP1 recorded 21 bird species.

4.2.3 Nocturnal and Diurnal Active Searches

Nocturnal searches conducted independently of other sites recorded six native amphibians, three bird species, two mammals including one bat, six native reptiles and the Cane Toad.

Figure 19: Fawn Antechinus captured in an Elliott trap

Figure 20: White-bellied Sea-eagle in nest, photographed though spotting scope

4.2.4 Acoustic Recording

The identification of bat species from full spectrum recordings was conducted by Kyle Armstrong and Yuki Konishi (Specialised Zoological) based on characteristic frequency, pulse shape, and the pattern of harmonics (Armstrong and Konishi 2013). Harmonic patterning was especially useful for distinguishing the Northern Free-Tailed Bat (*Chaerephon jobensis*) and the Yellow-Bellied Sheath-Tailed Bat (*Saccolaimus flaviventris*).

Armstrong and Konishi (2013) indicate that there were no acoustic features identified that suggested the presence of the Bare-Rumped Sheath-Tailed Bat (*S. saccolaimus)*. The identification of this species is based on an unpublished reference echolocation call set currently being prepared for publication, and diagnostic calls described by Coles et al. (2012).

Some call sequences could not be attributed reliably to one species (Armstrong and Konishi 2013):

- The calls of the Hoary Wattled Bat (*Chalinolobus nigrogriseus*) and little Broad-Nosed Bat (*Scotorepens greyii*) are similar and cannot be distinguished reliably.
- The calls of Long-Eared Bats (*Nyctophilus* spp.) are typically difficult to identify to species, and those recorded may be attributed to the Northern Long-Eared Bat (*N. arnhemensis*), the Pallid Long-Eared Bat (*N. daedalus*) or the Lesser Long-Eared Bat (*N. geoffroyi*).
- Likewise, the calls of the Northern Bent-Winged Bat (*Miniopterus oceanensis orianae*) and Forest Pipistrelle *Pipistrellus adamsi* cannot be distinguished reliably for some call types.

The calls attributed to the Common Sheath-Tailed Bat (*Taphozous georgianus*) are approximately 3 – 4 kHz higher than seen across their range (typically the characteristic frequency of the second harmonic is approximately 25 kHz). A much smaller proportion of *Taphozous* calls were observed with a characteristic frequency of approximately 25 kHz. The higher frequency types resemble calls from Hill's Sheath-Tailed Bat *T. hilli*, but this species is found much further south in arid parts of the Northern Territory.

4.2.5 Remote Cameras and Hair Tubes

One limitation of remote cameras is that the number of images captured is not directly related to the number of individuals involved, or the overall abundance of the species (a single individual could be recorded in sequential sets of images, or multiple individuals could be recorded within a set of images taken in direct succession). We therefore refer to ‘observations’ that are comprised of a set of images, presumably of the same animal taken consecutively.

Thirty cameras captured a total of 248 ‘observations’ (Table 8). The Common Brushtail Possum (*Trichosurus vulpecula*), the Cat (*Felis catus,* Figure 21) and the Domestic Dog (*Canis lupus familiaris*) had not been recorded at the site by other survey methods. The NT listed Endangered Fawn Antechinus was recorded from an additional two locations (Figure 22). Transects I and J (*Corymbia* and *Eucalyptus tetrodonta* open woodland and riparian *Melaleuca viridiflora* woodland respectively) yielded the most observations and the highest diversity of species. The results of the camera survey suggest that mammals occur at fairly high densities on the site - a result which was not reflected in the results of trapping and other surveys. For example, 38 observations of the Northern Brown Bandicoot were recorded by the cameras, compared to one capture over a total of 96 cage trapping nights.

Unseasonal rain impacted on the hair tubes, reducing the stickiness of the tape within the first week of the survey period. Two mammal hair samples (each comprising a single hair) were sent for analysis[1], one was identified as a Dingo hair, and the other was a contaminant human hair.

Table 8: Remote camera records

Species	Number of observations at each transect					
	G	H	I	J	K	L
Bird species						
Bar-shouldered Dove *Geopelia humeralis*				3		
Blue-winged Kookaburra *Dacelo leachii*	1		1			
Bush Stone-curlew *Burhinus grallarius*		4		4		
Double-barred Finch *Taeniopygia bichenovii*				1		
Peaceful Dove *Geopelia striata*			9	14	2	
Pheasant Coucal *Centropus phasianinus*			1	3		
Rainbow Bee-eater *Merops ornatus*			3			
Torresian Crow *Corvus orru*		1	1	2		
Willie Wagtail *Rhipidura leucophrys*						1
Native mammal species						
Agile Wallaby *Macropus agilis*	4	18	30	17	12	1
Common Brushtail Possum *Trichosurus vulpecula*	12	1	2	1	1	11
Dingo *Canis lupus dingo*			7	6		3
Fawn Antechinus – NT Endangered *Antechinus bellus*		1		1		

[1] Hair analysis was carried out by Barbra Triggs, Dead Finish Genoa, Victoria

Species	Number of observations at each transect					
	G	H	I	J	K	L
Northern Brown Bandicoot *Isoodon macrourus*	1	2	23	11		1
Reptile species						
Long-nosed Water Dragon *Lophognathus longirostris*				1		1
Port Essington Ctenotus *Ctenotus essingtonii*						1
Introduced species						
Cane Toad *Rhinella marina*			17		1	2
Cat *Felis catus*				1		
Pig *Sus scrofa*	4		1	2		
Total						
Number of observations	22	27	95	67	16	21
Number of species	5	6	11	14	4	8

Figure 21: Cat captured on camera

Figure 22: Fawn Antechinus captured by camera

4.2.6 Area Searches, Flushing Surveys and Incidental Observations

Area and flushing surveys were conducted while installing trap and camera transects, in conjunction with diurnal searches, during vegetation surveys and while driving the site. Two flocks (of 8-12, and 4

individuals) of EPBC and TPWC listed vulnerable Eastern Partridge Pigeons were observed on 7 and 10 September in the same area of *Eliocharis* sedgeland in Magela Creek to the south of Georgetown Billabong. Two burrows of EPBC listed migratory Rainbow Bee-eaters were observed in the sandy bed and bank of Magela Creek north of Georgetown Billabong (Figure 23). An EPBC listed White-bellied Sea-eagle was observed flying over woodland between transects H and I, this may have been one of the pair recorded at Georgetown Billabong.

Figure 23: Rainbow Bee-eater nest in Magela Creek

4.2.7 Threatened species observations

Seven EPBC or TPWC listed species were recorded within the survey area (Table 9). Migratory species were generally recorded in close proximity to Magela Creek, although Rainbow Bee-eaters were observed widely across the site (Figure 24). Eastern Partridge Pigeons were observed in *Eliocharis* sedgeland on the fringes of Georgetown Billabong and Fawn Antechinus were recorded in woodland at three locations.

Table 9: Threatened and migratory fauna species recorded in the current survey

Common name	EPBC status	NT status	Observation notes
Cattle Egret *Ardea ibis*	Migratory	None	A Cattle Egret was observed at Georgetown Billabong, 11 September
Eastern Great Egret *Ardea modesta*	Migratory	None	The Eastern Great Egrets were observed at Georgetown Billabong 7, 8,9 and 11 September, and RP1 on 10 September
Eastern Partridge Pigeon *Geophaps smithii smithii*	Vulnerable	Vulnerable	Two flocks of Eastern Partridge Pigeons were observed on 7 and 10 September in *Eliocharis* sedgeland in the southern dry section of Georgetown Billabong
Rainbow Bee-eater *Merops ornatus*	Migratory	None	Rainbow Bee-eaters were observed at Georgetown Billabong, transects A, B, C, E, F and in the Magela Creek bed thought the survey period. Two burrows were observed
White-bellied Sea-eagle *Haliaeetus leucogaster*	Migratory	None	A breeding pair of White-bellied Sea-eagles were observed at Georgetown Billabong throughout the survey period
Fawn Antechinus *Antechinus bellus*	None	Endangered	One female Fawn Antechinus was trapped adjacent to the proposed vent corridor at transect A. A further two were captured on camera at woodland transects H and J
Saltwater Crocodile *Crocodylus porosus*	Migratory	None	A saltwater Crocodile was observed at Georgetown Billabong on 7 and 10 September

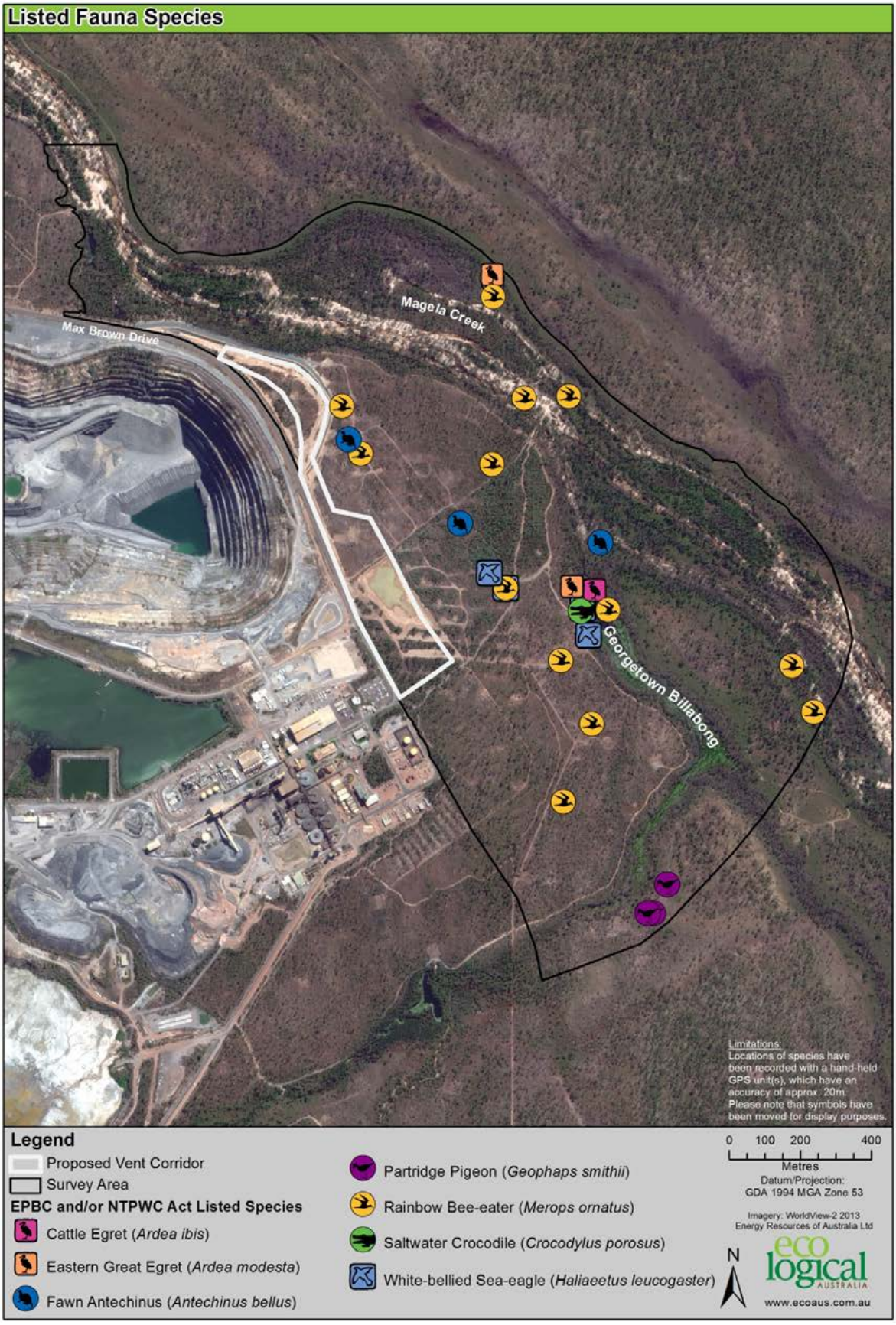

Figure 24: Listed fauna species recorded within the survey area

4.3 CONCLUSION

The range of species recorded during fauna surveys reflects the high richness of birds, and low diversity and abundance of small mammals (e.g. *Melomys* sp., *Antechinus* sp.) typical of Top End woodlands. While larger mammals (such as wallabies and dingos) remain common, many smaller species have undergone significant declines over most of the Top End during the last 20 years (Woinarski et al. 2010).

Wetland areas including RP1 and Georgetown Billabong had the highest species richness (primarily comprising birds). Eastern Partridge Pigeons (listed as vulnerable) were observed on two occasions in *Eliocharis* sedgeland at the edge of Magela Creek to the south of the Billabong.

Although woodland was not as species rich, three individuals of the endangered Fawn Antechinus were recorded in *Eucalyptus* woodland, including one recorded in a small patch of highly disturbed woodland (previously burnt and cleared) within 100 m of the boundary of the proposed vent corridor.

Trapping, camera and nocturnal surveys within or adjacent to the proposed vent corridor recorded 23 bird species, five native mammals, six reptiles and one introduced species (Table 11). The EPBC listed migratory Rainbow Bee-eater and the TPWC listed Fawn Antechinus were recorded in close proximity to the proposed vent corridor adjacent to the bunded levy area directly adjacent to Pit 3 (Figure 24).

The listed migratory species that were recorded within the survey area (Cattle and Eastern Great Egrets, Rainbow Bee-eater, White–bellied Sea-eagle and Saltwater Crocodile) are all species that are resident and commonly occur in suitable habitats in the Northern Territory. Within the survey site A, active Rainbow Bee-eater and White-Bellied Sea-eagle nests were recorded in the Magela Creek area. The survey was conducted outside the breeding season of the other migratory species present, but it can be assumed that they breed either within the survey area or in the surrounding KNP.

Table 10: Number of species recorded at each survey site

Site	Number of species
Within or adjacent to vent corridor	
Transect D + Nocturnal 5	18
Transect A + Nocturnal 6	13
Transect L	8
Nocturnal 4	5
Transect K	4
Nocturnal 7	2
Woodland	
Transect E	19
Transect B	16
Transect I	11
Acoustic survey	9
Transect H	6
Nocturnal 9	2
Nocturnal 8	1
Riparian	
Transect C	21
Diurnal 1	18
Transect J	14
Transect F	13
Diurnal 2	10
Transect G	5
Nocturnal 1	0
Nocturnal 2	0
Wetland	
Georgetown Billabong + Nocturnal 3	70
RP 1	20
Magela Creek	12
Other	
Incidental + other surveys	44

Table 11: Species recorded in or adjacent to the proposed vent corridor

Species	Trapping transect A, Nocturnal 6	Trapping transect D, Nocturnal 5	Camera transect K, Nocturnal 7	Camera transect L
Bird species				
Australasian Figbird *Sphecotheres vieilloti*	x			
Australian Owlet-nightjar *Aegotheles cristatus*	x			
Barking Owl *Ninox connivens*	x	x		
Bar-shouldered Dove *Geopelia humeralis*	x		x	
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	x			
Black-tailed Treecreeper *Climacteris melanura*		x		
Double-barred Finch *Taeniopygia bichenovii*	x	x		
Little Corella *Cacatua sanguinea*	x			
Mistletoebird *Dicaeum hirundinaceum*		x		
Nankeen Kestrel *Falco cenchroides*	x			
Peaceful Dove *Geopelia striata*			x	
Rainbow Bee-eater EPBC migratory *Merops ornatus*	x			
Rainbow Lorikeet *Trichoglossus haematodus*		x		
Red-backed Fairy-wren *Malurus melanocephalus*		x		
Red-winged Parrot *Aprosmictus erythropterus*		x		
Silver-crowned Friarbird *Philemon argenticeps*		x		
Sulphur-crested Cockatoo *Cacatua galerita*	x	x		

Species	Trapping transect A, Nocturnal 6	Trapping transect D, Nocturnal 5	Camera transect K, Nocturnal 7	Camera transect L
Torresian Crow *Corvus orru*		x		
Whistling Kite *Haliastur sphenurus*	x	x		
White-gaped Honeyeater *Lichenostomus unicolor*		x		
White-winged Triller *Lalage sueurii*	x			
Willie Wagtail *Rhipidura leucophrys*	x	x		x
Yellow Oriole *Oriolus flavocinctus*		x		
Mammal species				
Agile Wallaby *Macropus agilis*			x	x
Common Brushtail Possum *Trichosurus vulpecula*			x	x
Dingo *Canis lupus*				x
Fawn Antechinus – TPWC Endangered *Antechinus bellus*	x			
Northern Brown Bandicoot *Isoodon macrourus*				x
Reptile species				
Bynoe's Gecko *Heteronotia binoei*	x	x		
Long-nosed Water Dragon *Lophognathus longirostris*				x
Marbled Velvet Gecko *Oedura marmorata*		x		
Northern Dtella *Gehyra australis*		x	x	
Port Essington Ctenotus *Ctenotus essingtonii*				x
Zig-zag Gecko *Oedura rhombifer*	x	x	x	
Introduced species				

Species	Trapping transect A, Nocturnal 6	Trapping transect D, Nocturnal 5	Camera transect K, Nocturnal 7	Camera transect L
Cane Toad *Rhinella marina*		X	X	X

5 HABITAT VALUES

To establish a broader context for the evaluating the potential impacts of the project on fauna species, the important habitat values of the survey area were assessed using information generated from the vegetation mapping, vegetation condition assessment and fauna likelihood analysis.

5.1 BACKGROUND

The EPBC survey guidelines for mammals, birds and reptiles state that a detailed map of the study area should be developed to reveal the type, locations and condition of important fauna habitat features (DEWHA 2008 and 2010, SEWPaC 2011). Eco Logical Australia developed a method to combine vegetation community and condition information to evaluate the location and condition of relevant habitat resources within the proposed vent corridor and the surrounding survey area. Habitat resources of importance to fauna species in tropical savanna landscapes include:

- wetlands and water sources
- nectar or fleshy fruit-bearing flowering tree species
- tree hollows and hollow logs
- seed bearing grasses.

5.1.1 Wetlands and Water Sources

Water is a key resource for many fauna species in this environment which experiences prolonged dry seasons. Wetlands and other water sources are critical landscape features and become increasingly important late in the dry season when species that need to drink frequently congregate around available water.

5.1.2 Nectar or Fleshy Fruit Bearing Flowering Tree Species

Nectar and fruits provide supplementary or core food sources for a variety of vertebrates including birds, mammals (e.g. gliders, possums and fruit- and / or microbats) and occasionally geckos. Given the seasonality of nectar and fruit production for each tree species, a variety of species in good condition provide year round food resources.

5.1.3 Tree Hollows and Hollow Logs

Hollows in living or dead trees, or hollow logs on the ground, provide nesting, roosting, or denning sites for a range of vertebrates. Hollow availability in some circumstances can be the limiting factor on fauna population sizes (Gibbons and Lindenmayer 2002). A variety of environmental processes, including insect damage, attack by micro-organisms, wind breakage, lightning strike or fire, may cause or influence the development of hollows and suitable hollows are more likely to occur in older trees. A diversity of hollows of different widths, diameters, heights, angles, orientations and tree species provides the optimal mix of habitat for a variety of vertebrate species. This diversity of hollows can only occur where vegetation succession isn't disturbed by factors such as cyclones or repeated hot fires.

5.1.4 Seed Bearing Grasses

Grass seeds provide core or supplementary food sources for a range of bird and mammal species. Grass seeds can be eaten directly from the plant or after seed fall, particularly after fire clears the plants and makes seeds easily accessible. A range of annual and perennial plants flower and seed throughout the year and provide a year-round food source.

5.2 METHODS

Ratings for fauna habitat characteristics were assigned to each vegetation polygon based on a combination of general characteristics and specific measures of condition and disturbance history (Table 12).

Table 12: Methodology and ratings employed to assess fauna habitat resources across the survey area

Fauna habitat resource	Method of assessment
Wetlands and other water sources	Distance and access to water was assessed.
Nectar or fleshy fruit bearing flowering tree species	Quality of resource based on the density, variety, and condition of flowering and fruiting trees. Rated 'poor', 'good' or 'excellent'
Tree hollows and hollow logs	Hollows cannot always be identified or evaluated via ground-based inspection, so the quality of available hollows was estimated based on vegetation height, diversity and fire history. Rated 'poor', 'good' or 'excellent'
Seed bearing grasses	The quality of this resource within each polygon was determined based on the range and density of grass species. Rated 'poor', 'good', 'excellent'

Vegetation mapping groups were further amalgamated into vegetation habitat types to reflect the provision of similar fauna habitat resources—for example all grassland mapping groups were amalgamated into the vegetation habitat type 'grassland' since they provide seed resources. A broad summary of fauna habitat resources in each vegetation habitat type is given in Table 13.

Table 13: Broad summary of fauna habitat resources in each vegetation habitat type.

Vegetation habitat type	Availability of nectar, fruit and seeds	Availability of hollows	Availability of grass seeds
Acacia shrubland	Poor – *Acacia* leaf glands secrete nectar which is a food source primarily for invertebrates. Honeyeaters have also been observed feeding on *Acacia* nectar. Parrots may eat seeds.	Poor – *Acacias* generally do not form hollows suitable for vertebrate fauna	Poor to good – depending on fire history and openness, *Acacia* can have a grass seed bearing understorey

Vegetation habitat type	Availability of nectar, fruit and seeds	Availability of hollows	Availability of grass seeds
Corymbia and *Eucalytpus* woodland	Poor to excellent – *Corymbia* and *Eucalyptus* flowers can provide a good source of nectar used by mammals, birds and occasionally geckos. Gumnuts provide a food source for parrots.	Good to excellent – depending on fire history, mature *Eucalyptus* and *Corymbia* woodland can provide suitable hollows in live trees and fallen wood	Poor to excellent – the quality of grassy understory within woodland is determined by the fire history and consequently openness of the vegetation community
Georgetown Billabong surrounds	Poor – the Georgetown Billabong area is populated by perennial species	Poor – the Georgetown Billabong are is populated by perennial species	Excellent – the Georgetown Billabong area supports grasses that seed throughout the year
Grasslands	Poor – few species within grasslands produce nectar or fruit	Poor – grasslands may support low densities of hollow bearing trees or fallen logs,	Good to excellent – depending on fire history
Riparian	Good to Excellent- *Melaleuca* flowers produce nectar that is eaten by birds and mammals, including bats. Many riparian trees including Eucalyptus product fruit.	Good - Hollows occur in riparian Eucalyptus	Good to excellent – Riparian areas support large patches of grasslands and woodlands with grass understorey
Cleared	Poor	Poor	Poor

5.3 RESULTS

Access to water is excellent across the entire site, due to the proximity to Magela Creek which incorporates both Georgetown Billabong, and a series of permanent pools. Outside of the survey area, water is also available on a relevant spatial scale from other creeks, and numerous sumps and constructed wetlands, such as Retention Pond 1.

Nectar, fruit and seed availability is highest within the riparian vegetation surrounding Magela Creek and in good quality woodland in the surrounding area (Figure 25). Within the proposed vent corridor the availability of nectar, fruit and seeds ranges from poor to good. The availability of hollows within the survey area is generally good, with older stands of Eucalyptus and Corymbia that have not been subjected to frequent burning providing excellent hollow availability (Figure 26). Grass seed availability is excellent within the riparian vegetation surrounding Magela Creek and generally good throughout the rest of the survey area (Figure 27).

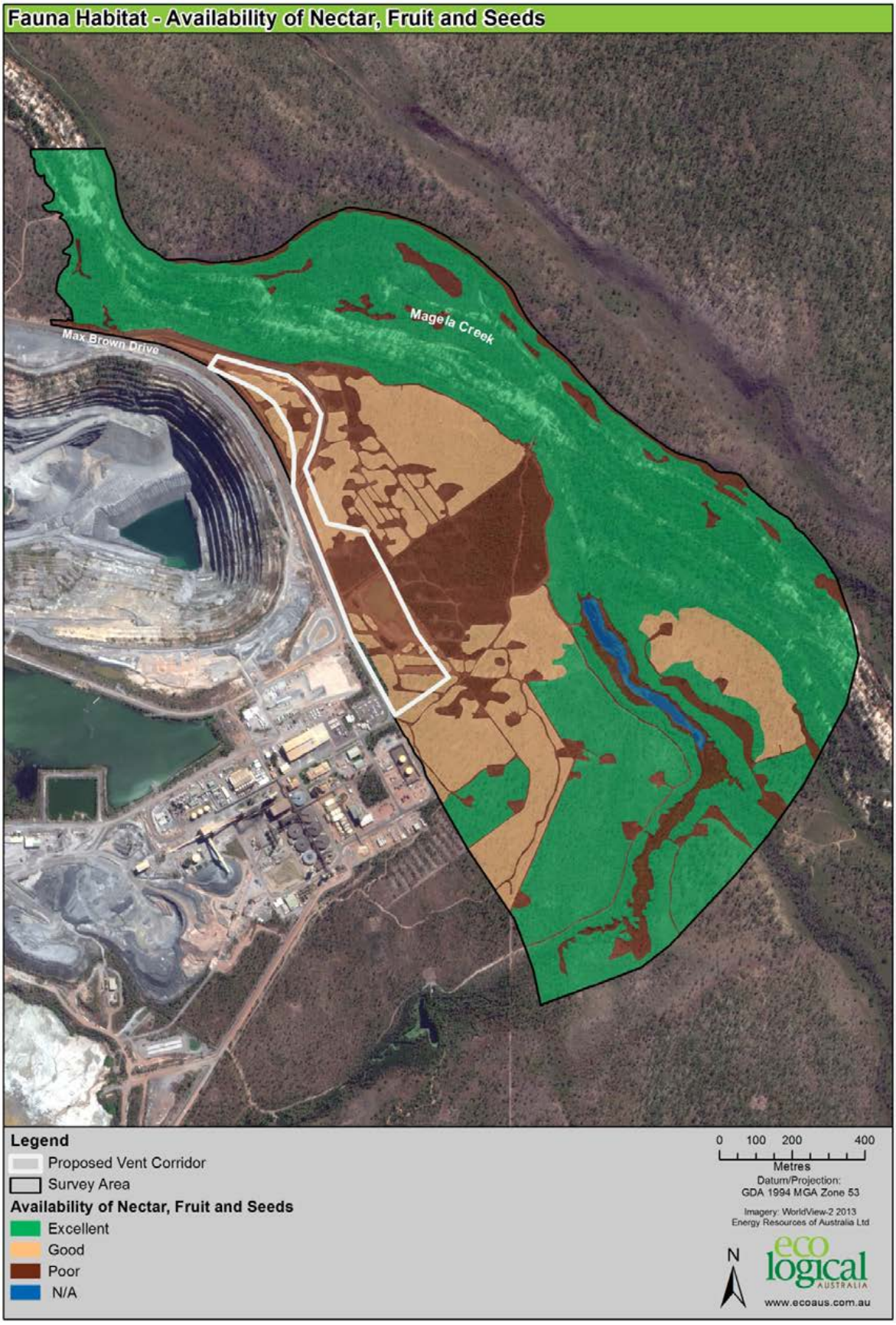

Figure 25: Fauna habitat resources - nectar, seed and fruit availability

Figure 26: Fauna habitat resources - availability of hollows

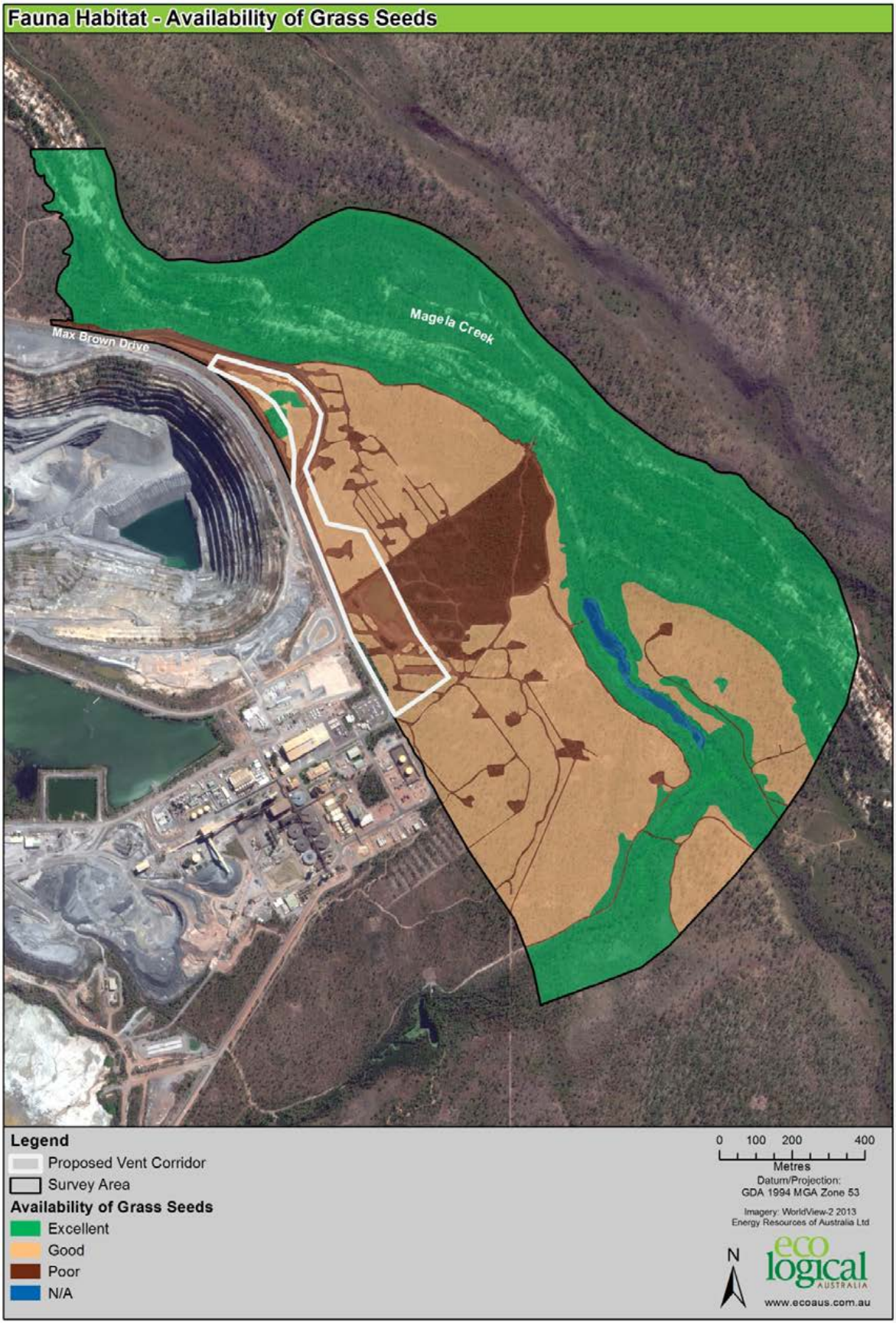

Figure 27: Fauna habitat resources - availability of grass seeds

5.4 CONCLUSION

The survey area supports areas of high quality (rated 'excellent') fauna habitat value. These areas exist mostly outside of and at distance from the proposed vent corridor (Figures 21-23). Disturbance arising from construction within the proposed vent corridor will impact on an area assessed as mostly providing 'poor' to 'good' habitat values (for each of the identified characteristics).

The lower habitat values within the vent corridor are consistent with the previous disturbance history and vegetation condition. More than half of the vent corridor is either currently cleared of native vegetation or has been previously cleared, supporting native vegetation at various states of regrowth.

Almost half of the survey area supports riparian vegetation communities, with the majority in excellent condition (see section 3.2.2) and providing excellent fauna habitat values for a range of species including birds, mammals and reptiles. Disturbance arising from construction within the proposed vent corridor would occur outside of these areas of high fauna habitat value.

6 POTENTIAL IMPACTS ON MNES FROM VEGETATION CLEARING

The EIS guidelines for the project list numerous potential impacts of the proposed development relating to flora and fauna (NT EPA and SEWPaC 2013). Potential impacts include vegetation clearance, habitat fragmentation, impacts on surface and groundwater systems, altered hydrology, soil compaction and noise and dust impacts. This assessment is, however, limited to the significance of any potential impacts of vegetation clearance and resulting habitat fragmentation on MNES in relation to the *EPBC Act Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Commonwealth of Australia 2009).

In making the Project a controlled action under the EPBC Act, the Commonwealth Government has determined that following MNES (relevant to this vegetation and fauna assessment) are applicable: world heritage properties and national heritage places; wetlands of international significance; listed ecological communities; and listed threatened and migratory species (Table 14).

Table 14: MNES recovered by a protected matters search of the survey area

MNES	Identity	Section
World heritage properties	Kakadu National Park	4.1
National heritage places	Kakadu National Park	4.1
Wetlands of international importance	Kakadu (stage 1 and 3) Kakadu (stage 2)	4.2
Listed ecological communities	Arnhem Plateau Sandstone Shrubland Complex	4.3
Listed threatened species	2 plant species 16 animal species (see Table 21)	4.3
Listed migratory species	18 species (see Table 31)	4.4

6.1 WORLD AND NATIONAL HERITAGE PLACES

6.1.1 Description

The proposed vent corridor is within the RPA, which is surrounded by, but separate from Kakadu National Park (KNP), a listed world and national heritage property. The park is listed for both its natural and cultural heritage values. The natural heritage values of the site are underpinned by the large size of the area and its relatively undisturbed state. The park landscape incorporates riparian and estuarine floodplains, rivers and associated catchments, intertidal mangroves, sandstone plateaus and escarpments. The landscape of Kakadu supports a range of habitats including open forest and woodland, shrubland and sandstone heath, lowland and sandstone rainforest patches, mangroves and freshwater wetlands. Features of special importance include significant plant associations, relict and endemic species and threatened plant and animal species and ecological communities.

A full description of the natural and cultural heritage values of the park is available from DoE at http://www.environment.gov.au/heritage/places/world/kakadu/values.html.

6.1.2 Nature and Extent of Likely Impact

The vegetation clearing associated with the proposed development is considered highly unlikely to have a significant impact on any of the values of KNP (Table 15). The proposed disturbance involves clearing a small area (approximately 2 ha, depending on final design and construction requirements) within the RPA, in an area previously and substantially disturbed by exploration and 'land application' (the MLAA) (see section 0). The area to be disturbed lies directly adjacent to the existing mine and its main access road.

Table 15: Assessment of the likelihood of potential impacts of the vegetation clearing associated with the proposed developed on world and national heritage places using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
One or more of the World Heritage values to be lost	Unlikely	Clearance of a small amount of highly disturbed habitat within the RPA and directly adjacent to the existing mine will not have flow-on effects on the world heritage values of KNP.
One or more of the World Heritage values to be degraded or damaged	Unlikely	Clearance of a small amount of highly disturbed habitat within the RPA and directly adjacent to the existing mine will not have flow-on effects on the world heritage values of KNP.
One or more of the World Heritage values to be notably altered, modified, obscured or diminished.	Unlikely	Clearance of a small amount of highly disturbed habitat within the RPA and directly adjacent to the existing mine will not have flow-on effects on the world heritage values of KNP.

6.2 WETLANDS OF INTERNATIONAL IMPORTANCE

6.2.1 Description

The wetlands of KNP are considered to be internationally significant based on ecological, zoological and botanical significance criteria (Finlayson et al. 2006, Ramsar 1971). Wetlands International site 5AU002 conforms to the boundaries of the park and includes 43,490 ha of wetland habitat made up of intertidal flats, mangrove swamps, marine subtidal aquatic beds, coastal saline / brackish / freshwater lagoons, rocky marine shores, permanent freshwater lakes, floodplains, freshwater springs, and permanent water courses. Wetlands within the site are largely undisturbed and support an array of environmental values including rare, endemic and listed threatened and migratory species and a vast number of waterbirds.

6.2.2 Nature and Extent of Likely Impact

Clearing for the proposed development does not impinge on any significant riparian areas. Potential indirect impacts on wetland areas from clearing in terrestrial areas relate to erosion and sediment control which is managed as part of the Ranger mine's overall site water management plan. Clearing of native vegetation associated with the development is considered highly unlikely to have a significant impact on any of the values of wetlands in KNP (Table 16).

Table 16: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on wetlands of international importance using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Areas of the wetland being destroyed or substantially modified	Unlikely	Clearance of approximately 2 ha of previously disturbed woodland within the RPA will not have flow-on effects on the Kakadu NP wetlands.
A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland	Unlikely	Clearance of approximately 2 ha of previously disturbed woodland will not change the hydrological regime of the Kakadu NP wetlands.
The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected	Unlikely	Clearance of approximately 2 ha of previously disturbed woodland will not have any effects of native species within the Kakadu NP wetlands.
a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health	Unlikely	Clearance of approximately 2 ha of previously disturbed woodland within the RPA will not have flow-on effects on water quality of the Kakadu NP wetlands.

Significant impact criteria	Likelihood	Assessment
An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact ecological character of the wetland will be introduced.

6.3 LISTED THREATENED SPECIES AND ECOLOGICAL COMMUNITIES

6.3.1 Description

An assessment of the likelihood of each EPBC and TPWC listed threatened plant and animal species occurring within or near the proposed vent corridor was conducted (full details are available in Appendices A, B and C). All plant species and ecological communities assessed that were rated as highly unlikely and are not treated further. Four bird and four mammal species were rated as 'known' or 'likely' within the survey area (Table 17). The regional distribution and ecology of each species is discussed below with a consideration of the survey findings and assessment of potential impact. Species that were identified in the guidelines for the EIS (NT EPA and SEWPaC 2013) are also included, such as the Plains Death Adder and Yellow Chat (Alligator Rivers).

6.3.2 Nature and Extent of Likely Impact

Species-specific assessments of impact significance addressing the significant impact criteria for *EPBC Act Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Commonwealth of Australia 2009), refined from those presented in the project referral, are presented in the Tables below.

Overall, the clearing of native vegetation associated with the proposed development is considered highly unlikely to have a significant impact on any threatened species at a regional or national scale. The proposed disturbance involves clearing a small area (approximately 2 ha) within a substantially disturbed area previously used for 'land application' disposal of excess water, and which has been the subject of recent exploration clearing and drilling (see section 0). The area to be disturbed lies directly adjacent to the existing mine and its main access road, so will not cause fragmentation of any existing habitat or fauna populations. Although it is possible that threatened species occur in the proposed vent corridor from time to time, the area contains habitat values rated mostly as poor to good, and there are substantial areas of high quality (rated excellent) habitat in the surrounding survey area (see section 5.4).

Table 17: Listed threatened species that are known or likely to occur in the vent corridor and surrounds

Common name	EPBC status	TPWC status	Likelihood of occurrence*
EPBC listed threatened bird species			
Eastern Partridge Pigeon *Geophaps smithii smithii*	Vulnerable	Vulnerable	Known
Northern Masked Owl *Tyto novaehollandiae kimberli*	Vulnerable	Vulnerable	Likely
Red Goshawk *Erythrotriorchis radiatus*	Vulnerable	Vulnerable	Likely
Yellow Chat (Alligator Rivers) *Epthianura crocea tunneyi*	Endangered	Endangered	Highly unlikely
EPBC listed threatened mammal species			
Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus nudicluniatus*	Critically endangered	Not listed	Likely
Brush-tailed Rabbit-rat *Conilurus penicillatus*	Vulnerable	Endangered	Possible (formerly 'known')
Northern Quoll *Dasyurus hallucatus*	Endangered	Critically endangered	Possible (formerly 'known')
EPBC listed threatened reptile species			
Plains Death Adder *Acanthophis hawkei*	Vulnerable	Vulnerable	Highly unlikely
TPWC listed threatened mammal species			
Fawn Antechinus *Antechinus bellus*	Not listed	Endangered	Known

*Likelihood definitions:
'Known' = the species has been recorded within the project area within the last decade.
'Likely' = a medium to high probability that a species uses the site. The species has been recorded within the local area and habitat within the site is considered to be highly suitable.
'Possible' = a medium to low probability that a species used the site. The species has been recorded within the local area or region and habitat within the site is considered to be moderately suitable. Species recorded in the area prior to recent population declines are included in this category. 'Unlikely' = a very low to low probability that a species uses the site. The species may or may not occur locally or regionally, however based on the known habitat requirements of the species, and habitat available within the site, the site is considered unlikely to be suitable or marginal at best.
'Highly unlikely'= habitat on site and in the vicinity is highly unsuitable for the species. Based on the known habitat requirements of the species, the site lacks the required habitat.

Eastern Partridge Pigeon (*Geophaps smithii smithii*)

The eastern subspecies of the Partridge Pigeon (*Geophaps smithii smithii*) is listed as Vulnerable under EPBC and TPWC legislation.

Regional distribution and ecology

The Eastern Partridge Pigeon is restricted to sub-coastal areas of the Top End; most recent records are from KNP and between Katherine and Darwin. The Eastern Partridge Pigeon prefers open forest and woodland dominated by Darwin Stringybark (*Eucalyptus tetrodonta*) and Darwin Woolybutt (*E. miniata*) with a structurally diverse understorey.

The Eastern Partridge Pigeon is relatively sedentary and will commonly occupy the same area throughout the year if there is permanent water nearby. It nests on the ground usually in a shallow depression lined with grass or leaves. It has been known to lay eggs in all months of the year, although the bulk of nesting occurs in the early to mid-dry season. It forages on a wide variety of seeds from grasses, legumes, herbs and also shrubs and trees (DoE 2013b).

Land use activities such as vegetation clearing, overgrazing and particularly the change from patchy fires over time to a late dry season fire regime can result in detrimental changes to the structure and floristic composition of the open forest and woodland habitat occupied by Eastern Partridge Pigeon (DoE 2013b).

Potential habitat, survey effort and findings

Critical habitat for the Eastern Partridge Pigeon comprises intricately burnt mosaics within open forests with grassy understorey (Fraser et al. 2003, Woinarski 2004). The species nests in the early dry season in patches of unburnt *Sorghum* in that matrix. This habitat occurs within the survey area, but the proposed vent corridor does not contain, or cross through suitable habitat.

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Studies were conducted between 1994 and 2011, and used a variety of methods implemented throughout the year (Appendices L and M). Eastern Partridge Pigeons have been recorded fairly frequently within the RPA including within the areas directly adjacent to the mine site itself (Brady et al 2006, Firth 2008a, Firth 2008b, Firth 2010a, Firth and Davey 2011, Smith 2009 and ERA's 2007 bird watch event).

Surveys conducted between 4 and 11 September 2013 within the vent corridor and the surrounds incorporated area and transect surveys, flushing surveys and waterhole survey for Eastern Partridge Pigeons. Two flocks (of 8-12, and 4 individuals) were observed in *Eliocharis* sedgeland in the dry southern section of Georgetown Billabong.

Species specific assessment of impact significance

As per the assessment presented in Table 18, it is considered unlikely that there will be significant impacts on Partridge Pigeons from clearing of native vegetation associated with the proposed development.

Table 18: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Eastern Partridge Pigeon using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Leads to a long-term decrease in the size of an important population of Eastern Partridge Pigeons	Unlikely	It is unlikely that clearing within the proposed vent corridor will have any impact on the local population of Eastern Partridge Pigeons as the species remains common in the undisturbed parts of the RPA, and a significant population occurs in neighbouring KNP. The above ground impact of the proposed development will be limited to a small amount of clearing within a highly disturbed area and is unlikely to lead to any long term impact on Eastern Partridge Pigeon populations.
Reduce the area of occupancy of an important population of Eastern Partridge Pigeons	Unlikely	Eastern Partridge Pigeons remain common in the undisturbed parts of the RPA, and a significant population occurs in neighbouring KNP. The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to reduce the area of habitat used by the local Eastern Partridge Pigeon population.
Fragment an existing important population of Eastern Partridge Pigeons into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any fauna populations or habitat.
Adversely affect habitat critical to the survival of Eastern Partridge Pigeons	Unlikely	Critical habitat for the Eastern Partridge Pigeon comprises intricately burnt mosaics within open forests with grassy understorey (Woinarski 2004). This habitat does not occur within the area to be cleared.
Disrupt the breeding cycle of an important population of Eastern Partridge Pigeons	Unlikely	The area to be cleared does not include suitable breeding or feeding habitat for Eastern Partridge Pigeons, and the scale of the project means it is unlikely to have any impact on the breeding cycles of the adjacent populations.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Eastern Partridge Pigeons is likely to decline	Unlikely	Clearance of approximately 2 ha within the heavily impacted Magela Land Application Area will not reduce the availability or quality of habitat within the region.
Result in invasive species that are harmful to Eastern Partridge Pigeons becoming established in the vulnerable species' habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Eastern Partridge Pigeon habitat will be introduced.
Introduce disease that may cause the Eastern Partridge Pigeon to decline	Unlikely	The proposed action is unlikely to introduce a disease that would impact Eastern Partridge Pigeons.

Northern Masked Owl (Tyto novaehollandiae kimberli)

The Northern Masked Owl is listed as Vulnerable under both the EPBC Act and the TPWC Act.

Regional distribution and ecology

The Northern Masked Owl is a subspecies of the Masked Owl (*Tyto novaehollandiae*). Little is known of the distribution of the Northern Masked Owl, and three subpopulations have been suggested: the Kimberley region of WA; the Top End of the NT; and Cape York in far north QLD. In northern Australia, the Northern Masked Owl has been recorded from riparian forest, rainforest, open forest, *Melaleuca* swamps and the edges of mangroves and along the margins of sugar cane fields (DoE 2013b).

The Northern Masked Owl breeds between March and October, typically nesting in large tree bearing hollows, within patches of closed forest (DoE 2013b). A study of the southern subspecies *T. novaehollandiae* reported that pairs occupy a large home range (approximately 1000 ha) and thus occur at low densities (Kavanagh and Murray 1996). The same study recorded a female spending more than 80 % of its time in, or next to, extensively modified environments, frequently using ecotones between bushland and open country for foraging.

Although the reason for the low population of the Northern Masked Owl is not certain, the subspecies has undoubtedly been affected 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 (Woinarski 2004). Recorded declines of small mammals in the Top End of the Northern Territory may have reduced prey availability for masked owls (Woinarski 2004).

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Although studies were conducted between 1994 and 2011, using a variety of methods, none of the studies included Northern Masked Owl call playback (Appendices L and M).

Surveys conducted between 4 and 11 September 2013, within the vent corridor and the surrounds incorporated call playback for Northern Masked Owls and was conducted over five nights. No responses were recorded.

The area to be cleared does not contain old Eucalyptus with large hollows suitable for breeding, although the area may be used for foraging.

Assessment of potential impact

The proposed vent corridor would represent less than 1% of the 1000 ha home range of any Northern Masked Owls in the area and breeding. As per the assessment presented in Table 19, it is considered unlikely that there will be significant impacts on Northern Masked Owls from the clearing of native vegetation associated with the proposed development.

Table 19: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Northern Masked Owl using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of an important population of Northern Masked Owls	Unlikely	The above ground impact of the proposed development will be limited to a small amount of clearing within a highly disturbed area, and is unlikely to lead to any long term impact on Northern Masked Owl populations.
Reduce the area of occupancy of an important population of Northern Masked Owls	Unlikely	Northern Masked Owls have not been recorded within or near the proposed vent corridor; the area therefore is unlikely to support an important population of the species. If the area does support Northern Masked Owls, the removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to reduce the area of habitat being used.
Fragment an existing important population of Northern Masked Owls into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any fauna population or habitat.
Adversely affect habitat critical to the survival of Northern Masked Owls	Unlikely	The Northern Masked Owl typically nests in large trees bearing hollows which do not occur within the proposed area of disturbance. No other critical habitat features for this species have been identified (Woinarski, 2004).
Disrupt the breeding cycle of an important population of Northern Masked Owls	Unlikely	The Northern Masked Owl typically nests in large trees bearing hollows which do not occur within the proposed area of disturbance. Clearance of approximately 2 ha is unlikely to reduce prey abundance at a level that would impact breeding.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that Northern Masked Owls is likely to decline	Unlikely	Clearance of approximately 2 ha within the heavily impacted MLAA will not reduce the availability or quality of habitat within the region.
Result in invasive species that are harmful to a vulnerable species becoming established in Northern Masked Owls habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Northern Masked Owl habitat will be introduced.
Introduce disease that may cause the Northern Masked Owls to decline	Unlikely	The proposed action is highly unlikely to introduce a disease that would impact Northern Masked Owls.

Red Goshawk (*Erythrotriorchis radiatus*)

The Red Goshawk, *Erythrotriorchis radiatus*, is listed as Vulnerable under both the EPBC Act and the TPWC Act.

Regional distribution and ecology

The Red Goshawk is endemic to Australia and is sparsely distributed across approximately 15 % of coastal and sub-coastal Australia, from the western Kimberley in WA to north eastern NSW, and occasionally on continental islands (DERM 2012).

The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia. In the NT, the Red Goshawk prefers tall open forest and woodland, or tall fringing woodlands along rivers in grasslands, shrublands, and low open woodlands (NSW National Parks & Wildlife Service 2002). The species prefers extensive open forest, open woodlands and riparian vegetation dominated by mature *Eucalyptus tetrodonta*, *E. miniata*, and *Melaleuca leucadendron* (DERM 2012). Forests of intermediate density are preferred, or ecotones between habitats of differing densities (DoE 2013b). Red Goshawks avoid very dense and very open habitats (DoE 2013b).

The Red Goshawk is a solitarily breeder, preferring forested or wooded areas (within large areas of intact native forest and woodland), close to permanent water, and in a large (over 20 m tall) trees. Nest trees have always been found within 1 km of permanent water, often adjacent to rivers or clearings. Red Goshawks hunt and breed in both lowland and rugged terrain (DERM 2012), where their diet consists largely of birds (95 %) (DoE 2013b). Records of this species indicate breeding activity occurs from August to November.

The main threats to the species include habitat loss and fragmentation, disturbance of nests (including burning), and reduction of prey availability (DERM 2012).

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Studies were conducted between 1994 and 2011, using a variety of methods (Appendices L and M), and no Red Goshawks were reported.

Area surveys for Red Goshawk nests conducted between 4 and 11 September 2013 within the vent corridor and the surrounds did not identify any nests.

Assessment of potential impact

Given that Red Goshawks are dependent on large tracts of intact native forest and woodland, the area within the proposed vent corridor is unlikely to provide any significant habitat for Red Goshawks. As per the assessment presented in Table 20, it is considered unlikely that there will be significant impacts on Red Goshawk from the clearing of native vegetation associated with the proposed development.

Table 20: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Red Goshawk using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of an important population of Red Goshawks	Unlikely	Infrastructure for the proposed action will be restricted to the heavily disturbed areas of the Ranger Project Area, and is unlikely to lead to long term impacts on Red Goshawk populations.
Reduce the area of occupancy of an important population of Red Goshawks	Unlikely	The Red Goshawk has not been reported within the RPA. The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to reduce the area of habitat available to Red Goshawks.
Fragment an existing important population of Red Goshawks into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any fauna populations or habitat.
Adversely affect habitat critical to the survival of Red Goshawks	Unlikely	Critical habitat for Red Goshawks comprises large tracts of intact native forest and woodland. The clearing of a small area of heavily impacted habitat directly adjacent to the mine will not affect critical habitat in the region.
Disrupt the breeding cycle of an important population of Red Goshawks	Unlikely	The small area to be cleared will not reduce the available suitable habitat, and is unlikely to impact prey availability for the species during the breeding season.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Red Goshawks is likely to decline	Unlikely	Clearance of approximately 2 ha within the heavily impacted Magela Land Application Area will not reduce the availability or quality of habitat within the region.
Result in invasive species that are harmful to Red Goshawks becoming established in the vulnerable species' habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Red Goshawk habitat will be introduced.
Introduce disease that may cause the Red Goshawk to decline	Unlikely	The proposed action is unlikely to introduce a disease that would impact Red Goshawk.

Yellow Chat (Alligator Rivers) (*Epthianura crocea tunneyi*)

The Yellow Chat (Alligator Rivers) is listed as Endangered under EPBC and TPWC legislation.

Regional distribution and ecology

Northern Chats occur patchily across Northern Australia, on alluvial and marine floodplains. The Alligator Rivers Yellow Chat is restricted to floodplains from the Alligator River to the East Alligator River (DoE 2008). Yellow Chats forage for insects within grasses, herbs and sedges and stands of mangroves, and aggregate around persisting wet areas at the end of the dry season (Woinarski and Armstrong 2006).

The main threat to the Yellow Chat in the Alligator Rivers region is habitat alteration due to weeds and feral animals (especially wallowing and rooting by pigs).

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Studies were conducted between 1994 and 2011, using a variety of methods (Appendices L and M).

Surveys conducted between 4 and 11 September 2013 conducted within the vent corridor and the surrounds incorporated area searches for this species, but no suitable floodplain habitat or Yellow Chats were recorded.

Assessment of potential impact

As per the assessment presented in Table 21, it is considered unlikely that there will be significant impacts on Yellow Chat from the clearing of native vegetation associated with the proposed development.

Table 21: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Yellow Chat using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of a population of Yellow Chat	Unlikely	Infrastructure for the proposed action will be restricted to the heavily disturbed areas of the Ranger Project Area, and is unlikely to lead to long term impacts on Yellow Chat populations.
Reduce the area of occupancy of the Yellow Chat	Unlikely	The Yellow Chat has not been recorded within the RPA. The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to reduce the area of habitat available to Yellow Chats.
Fragment an existing population into two or more populations of the Yellow Chat	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any habitat.
Adversely affect habitat critical to the survival of the Yellow Chat	Unlikely	Critical habitat for Yellow Chats comprises alluvial and marine floodplains. The clearing of a small area of heavily impacted woodland habitat directly adjacent to the mine will not affect critical habitat in the region.
Disrupt the breeding cycle of a population of Yellow Chat	Unlikely	The small area to be cleared will not reduce the available suitable habitat, and is unlikely to impact prey availability for the species during the breeding season.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Yellow Chat is likely to decline	Unlikely	Critical habitat for Yellow Chats comprises alluvial and marine floodplains. The clearing of a small area of heavily impacted woodland habitat directly adjacent to the mine will not affect the availability of quality of suitable habitat in the region.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Yellow Chat habitat will be introduced.
Introduce disease that may cause the Yellow Chat to decline	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any disease that could impact Yellow Chat habitat will be introduced.
Interfere with the recovery of the Yellow Chat.	Unlikely	The proposed action is highly unlikely to introduce a disease that would impact the Yellow Chat.

Bare-rumped Sheath-tailed Bat (Saccolaimus saccolaimus nudicluniatus)

The Bare-rumped Sheath-tailed Bat is listed as Critically Endangered under EPBC legislation.

Regional distribution and ecology

The apparently disjunct distribution of the Bare-rumped Sheath-tailed Bat includes an eastern population occurring in a narrow coastal band from approximately Townsville through to north-eastern Cape York, including Magnetic Island, and a population in the Northern Territory seemingly restricted to the Kakadu lowlands and the Darwin area (Schulz and Thompson, 2007).

The preferred habitat for this species is rugged sandstone environments, typically where there are many caves, crevices or boulders and hollow trees; however the specimens collected in KNP were from open *Pandanus* woodland fringing the sedgelands of the South Alligator River (DoE 2013b). The ecology of the species is poorly known, although anecdotal evidence suggests they forage primarily for aerial insects over the woodland/forest canopy along vegetation boundaries.

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Although three surveys targeted microbats using Anabat recordings (Richards 1998, Corbett 2000, Corbett et al. 2004) the acoustic signature of the Bare-rumped Sheath-tailed Bat has only recently been documented (K. Armstrong, unpublished data).

Full spectrum recordings captured in the survey area between 4 and 11 September 2013 resulted in the identification of at least nine bat species, but did not detect the Bare-rumped Sheath-tailed Bat.

Assessment of potential impact

As per the assessment presented in (Table 22), it is considered unlikely that there will be significant impacts on Bare-rumped Sheath-tailed Bats from the clearing of native vegetation associated with the proposed development.

Table 22: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Bare-rumped Sheath-tailed Bat using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of a population of Bare-rumped Sheath-tailed Bats	Unlikely	Infrastructure for the proposed action will be restricted to the heavily disturbed areas of the Ranger Project Area, and is unlikely to lead to long term impacts on Bare-rumped Sheath-tailed Bat populations.
Reduce the area of occupancy of the Bare-rumped Sheath-tailed Bat	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to reduce the area of roosting or foraging habitat available to the Bare-rumped Sheath-tailed Bat.
Fragment an existing population of Bare-rumped Sheath-tailed Bats into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any fauna populations or habitat.
Adversely affect habitat critical to the survival of Bare-rumped Sheath-tailed Bats	Unlikely	Critical habitat for the Bare-rumped Sheath-tailed Bat is poorly known; however the highly impacted vent corridor is unlikely to be important for roosting or foraging.
Disrupt the breeding cycle of a population of Bare-rumped Sheath-tailed Bats	Unlikely	No suitable roosting habitat occurs within the area to be cleared. Prey availability during the breeding season will not be affected.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Bare-rumped Sheath-tailed Bat is likely to decline	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for Bare-rumped Sheath-tailed Bat.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the Bare-rumped Sheath-tailed Bats habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Bare-rumped Sheath-tailed Bat habitat will be introduced.
Introduce disease that may cause the Bare-rumped Sheath-tailed Bats to decline, or	Unlikely	The proposed action is highly unlikely to introduce a disease that would impact Bare-rumped Sheath-tailed Bat.
Interfere with the recovery of the Bare-rumped Sheath-tailed Bat	Unlikely	The recovery plan for the Bare-rumped Sheath-tailed Bat (Schulz and Thomson 2006) is focused on gathering information on the species, and protecting roosting habitat. These goals will not be affected by the proposed clearing.

Brush-tailed Rabbit-rat (*Conilurus penicillatus*)

The Brush-tailed Rabbit-rat is listed as Vulnerable under the EPBC Act and endangered under the TPWC Act.

Regional distribution and ecology

The Brush-tailed Rabbit-rat shelters in tree hollows, hollow logs and occasionally in the crowns of Pandanus or Sand-palms (Woinarski and Hill 2012). This species occurs in Eucalyptus tall open forest and in the coastal grasslands on the Cobourg Peninsula (Woinarski and Hill 2012). It has not been recently recorded within its historical range in the NT (DoE 2013b; Woinarski and Hill 2012), including KNP (Firth et al. 2010). The Brush-tailed Rabbit-rat is currently known to persist in the NT only on Cobourg Peninsula, Bathurst, Melville and Inglis Islands and Groote Eylandt (Woinarski and Hill 2012). The recent decline of the species has most likely been caused by feral cats and other predators and / or disease (Woinarski and Hill 2012). Altered fire regimes, weeds and grazing may also have changed the availability of preferred food sources, hollow logs, tree hollows, fruit-bearing shrubs and grass species composition (Woinarski and Hill 2012).

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Studies were conducted between 1994 and 2011, using a variety of methods (Appendices L and M). Brush-tailed Rabbit-rats were common throughout Eucalyptus woodland in the area, but have declined to near extinction since the late 1980s.

Surveys conducted between 4 and 11 September 2013 conducted within the vent corridor and the surrounds incorporated daytime searches for potentially suitable habitat resources, trapping and spotlight surveys for the Brush-tailed Rabbit-rat. No Brush-tailed Rabbit-rats were recorded.

Assessment of potential impact

As per the assessment presented in (Table 23), it is considered unlikely that there will be significant impacts on Brush-tailed Rabbit-rats from the clearing of native vegetation associated with the proposed development.

Table 23: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Brush-tailed Rabbit-rat using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of an important population of Brush-tailed Rabbit-rats	Unlikely	The Brush-tailed Rabbit-rat is thought to have declined to near extinction in KNP since the 1980s. Infrastructure for the proposed action will be restricted to the heavily disturbed areas of the Ranger Project Area, and is unlikely to lead to long term impacts on Brush-tailed Rabbit-rat populations.
Reduce the area of occupancy of an important population of Brush-tailed Rabbit-rats	Unlikely	The Brush-tailed Rabbit-rat has not been reported within the RPA. The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to reduce the area of habitat available to Brush-tailed Rabbit-rats.
Fragment an existing important population of Brush-tailed Rabbit-rats into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any fauna populations or habitat.
Adversely affect habitat critical to the survival of Brush-tailed Rabbit-rats	Unlikely	Critical habitat for Brush-tailed Rabbit-rats comprised mixed Eucalyptus open forest and woodland, or on dunes with Casuarina. The species prefers areas that are not burned frequently. The highly impacted area to be cleared is not critical habitat.
Disrupt the breeding cycle of an important population of Brush-tailed Rabbit-rats	Unlikely	The small area to be cleared will not reduce the available suitable habitat, and is unlikely to impact food availability for the species during the breeding season.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Brush-tailed Rabbit-rats is likely to decline	Unlikely	Clearance of approximately 2 ha within the heavily impacted Magela Land Application Area will not reduce the availability or quality of habitat within the region.
Result in invasive species that are harmful to Brush-tailed Rabbit-rats becoming established in the vulnerable species' habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Brush-tailed Rabbit-rat habitat will be introduced.
Introduce disease that may cause the Brush-tailed Rabbit-rat to decline	Unlikely	The proposed action is unlikely to introduce a disease that would impact Brush-tailed Rabbit-rat.

Northern Quoll (Dasyurus hallucatus)

The Northern Quoll is listed as Endangered under EPBC legislation and was elevated to Critically Endangered in the December 2012 revision of the listings under the TPWC Act.

Regional distribution and ecology

The historical distribution of the Northern Quoll ranged across northern Australia; the species occurred almost continuously from the Pilbara in WA to near Brisbane in Queensland (Braithwaite and Griffiths 1994). The Northern Quoll is now restricted to five regional distributions: central Qld coast, northern Qld, the Top End of the NT, the Kimberley (WA) and the Pilbara (DoE 2013b).

In the NT the species is restricted to the Top End mainland and smaller islands such as Vanderlin, Marchinbar, Inglis, Groote Eylandt and Northeast Island (DoE 2013b).

The Northern Quoll is the smallest, most arboreal and aggressive of the four Australian quoll species and is a nocturnal, carnivorous marsupial with a moderately large home range (DoE 2013b).

Northern Quolls reproduce once per year and have on average seven offspring per year. However, both male and female Northern Quolls have short life spans; the male often dies following the breeding season due to the intense physical effort from roving while the female usually survives only one breeding season (Oakwood 2000). This unique life history can exacerbate the effects of population decline and habitat loss, and make population recovery very slow (DoE 2013b).

Habitat for the Northern Quoll comprises some form of rocky area or structurally diverse woodland or forest for denning / shelter purposes, with surrounding vegetated habitats used for foraging and dispersal (SEWPaC 2011, DoE 2013b). Sandstone escarpment is considered prime habitat (Braithwaite and Griffiths 1994). Denning / shelter habitat is important for breeding, refuge from fire and / or predation, and long term viability of the species (DoE 2013b).

The decline of the Northern Quoll is one of the most marked examples of the trend of small mammal declines in the Top End. The most likely causes for the decline of small mammals across the Top End are too frequent fire, predation by feral cats and invasion by Cane Toads (*Rhinella marina*) (Woinarski et al. 2010). However, the rapid decline of the Northern Quoll, formerly a common native mammal species in KNP and elsewhere in the monsoonal tropics of the NT, is directly attributed to the Cane Toad invasion (Woinarski et al. 2010). Cane Toads are ingested by the Northern Quoll and cause lethal toxicity. The population has almost been entirely lost from the north east Top End, as well as the Cape York Peninsula and the Einasleigh Uplands of northern Queensland (DoE 2013b).

A *National Recovery Plan for the Northern Quoll Dasyurus hallucatus* was prepared by the NT Department of National Resources, Environment, Arts and Sport (now the Department of Land Resource Management) (Hill and Ward 2010).

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Studies were conducted between 1994 and 2011, using a variety of methods

(Appendices L and M). Quolls were recorded on the site in three surveys prior to 1998 but have not been recorded since and a likely to be locally extinct (ENV Australia 2012).

Surveys conducted between 4 and 11 August 2013 conducted within the vent corridor and the surrounds incorporated daytime searches for habitat and signs of activity and spotlight surveys, and remote cameras were deployed for at least 38 nights. No Northern Quolls or signs of quoll activity were recorded.

Northern Quolls historically used a broad range of habitat types in Northern Australia and created dens in rocky outcrops, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings. Since the crash of quoll populations, areas considered to be critical to the survival of the species are those most protected, including rocky areas and offshore islands (Hill and Ward 2010).

Assessment of potential impact

Northern Quolls appear to be locally extinct within the survey area, and across mainland NT. Northern Quolls utilise rocky outcrops, which do not occur within, or near, the vent corridor. As per the assessment presented in (Table 24), it is considered unlikely that there will be significant impacts on Northern Quolls from the clearing of native vegetation associated with the proposed development.

Table 24: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Northern Quoll using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of a population of Northern Quolls	Unlikely	Quolls have not been recorded in the RPA since 1998 and have undergone major population declines across the Northern Territory in the presence of Cane Toads. Clearance of approximately 2 ha of heavily impacted land within Magela Land Application Area will not lead to further population decreases.
Reduce the area of occupancy of the Northern Quoll	Unlikely	Quolls have not been recorded in the RPA since 1998; clearing of approximately 2 ha of heavily impacted land will not affect the area of occupancy of the species.
Fragment an existing population of Northern Quolls into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any habitat.
Adversely affect habitat critical to the survival of Northern Quolls	Unlikely	Habitat critical to the survival of Northern Quoll generally occurs in rocky areas and on offshore islands (Hill and Ward 2010). These habitats do not occur within the proposed vent corridor, or in the surrounds.
Disrupt the breeding cycle of a population of Northern Quolls	Unlikely	No suitable habitat occurs within the area to be cleared.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Northern Quoll is likely to decline	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for Northern Quolls. The species is unlikely to occur in the area.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the Northern Quolls habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Northern Quoll habitat will be introduced.
Introduce disease that may cause the Northern Quolls to decline	Unlikely	The proposed action is highly unlikely to introduce a disease that would impact Northern Quolls.
Interfere with the recovery of the Northern Quoll	Unlikely	The recovery plan for the Northern Quoll (Hill and Ward 2010) focuses on mitigating the threat posed by Cane Toads. The proposed project is unlikely to impact the spread or density of cane toads already present in the RPA.

Plains Death Adder (*Acanthophis hawkei*)

The Plains Death Adder (*Acanthophis hawkei*) is currently listed as Vulnerable under EPBC and TPWC legislation.

Regional distribution and ecology

The distribution of the Plains Death Adder is poorly understood, however the species is restricted to cracking black soil riparian plains in the north of Australia from western Queensland to the north east of Western Australia (Cogger, 2000). Populations are fragmented, and the species can be locally common. Radio tracking suggests that individuals are nomadic, with no fixed home range, and that movements are larger during the wet season. Like all Death Adders, the species is an ambush predator, waiting concealed under substrate including leaf litter or sand until prey approaches, the narrow tail tip is sometimes used as a lure.

Native frogs make up a large proportion of the diet of smaller individuals, making them susceptible to Cane Toads (Webb et al 2005). Habitat modification due to over-grazing or inappropriate fire regimes may also threaten the species.

Potential habitat, survey effort and findings

A review of previous terrestrial fauna surveys within the RPA (and in some cases including parts of KNP) identified 26 studies of terrestrial fauna including targeted surveys and monitoring programs (ENV Australia 2012). Studies were conducted between 1994 and 2011, and used a variety of methods implemented throughout the year (Appendices L and M).

Surveys conducted between 4 and 11 September 2013 within the vent corridor and the surrounds did not include specific searches for this species, as no suitable habitat occurs in the area.

Assessment of potential impact

As per the assessment presented in Table 25, it is considered unlikely that there will be significant impacts on Plains Death Adders from the clearing of native vegetation associated with the proposed development.

Table 25: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Plains Death Adder using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of an important population of Plains Death Adder	Unlikely	The above ground impact of the proposed development will be limited to a small amount of clearing within a highly disturbed area and is unlikely to lead to any long term impact on Plains Death Adders.
Reduce the area of occupancy of an important population of Plains Death Adder	Unlikely	No suitable habitat occurs with the RPA.
Fragment an existing important population of Plains Death Adder into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any habitat.
Adversely affect habitat critical to the survival of Plains Death Adder	Unlikely	No suitable habitat occurs within the RPA.
Disrupt the breeding cycle of an important population of Plains Death Adder	Unlikely	No suitable habitat occurs within the RPA. Plains Death Adders have not been reported in the region.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Plains Death Adder is likely to decline	Unlikely	No suitable habitat occurs within the RPA.
Result in invasive species that are harmful to a vulnerable species becoming established in the Plains Death Adder habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Plains Death Adders habitat will be introduced.
Introduce disease that may cause the Plains Death Adder to decline	Unlikely	The proposed action is highly unlikely to introduce a disease that would impact Plains Death Adders.

Fawn Antechinus (*Antechinus bellus*)

The Fawn Antechinus is not listed under EPBC legislation, but was listed as endangered in the December 2012 revision under the TPWC Act.

Regional distribution and ecology

The Fawn Antechinus is restricted to savanna woodland and tall open forest from the Top End of the Northern Territory, and one record exists for the species on the Tiwi Islands. The species uses tree hollows and fallen logs, and infrequently burnt habitat is more suitable. Like other Antechinus, males are annual and die after one breeding season (June to late August) (Young 2012).

Threats to this species include habitat modification due to inappropriate fire regimes, and predation by introduced predators (particularly cats) (Young 2012).

Potential habitat, survey effort and findings

The Fawn Antechinus has been recorded in several previous surveys within the RPA (including Firth 2010a, Firth 2008 a, b, Brady et al 2006) and was trapped at one site and photographed at two sites during the 2013 survey. All three locations were woodland – including a small highly degraded site within 100 m of the proposed vent corridor.

Assessment of potential impact

The Fawn Antechinus is not listed as threatened under EPBC legislation, and as such the significant impact guidelines for MNES do not strictly apply. The guidelines are however, a useful way to address the potential impact of the project on the species and are presented in Table 26.

Although it is considered likely that the area of occupancy of the species will be reduced by a small amount, the loss of approximately 2 ha within the proposed vent corridor is not likely to have a significant impact on the size of the local populations. Fawn Antechinus were recorded at three locations in woodland within the survey site, suggesting that the proposed vent corridor is not particularly significant habitat for the species, and that there is a population in the surrounding area that is unlikely to be impacted by the proposed works.

While two of the significant impact criteria are technically considered likely or possible (reduction of the area of occupancy, and disruption of the breeding cycle), it is considered unlikely that there will be significant impacts on Fawn Antechinus from the clearing of native vegetation associated with the proposed development.

Table 26: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Fawn Antechinus using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Lead to a long-term decrease in the size of a population of Fawn Antechinus	Unlikely	The area to be cleared is a small proportion of suitable habitat within the RPA. If the population is locally reduced by clearing, the long term effects should be mitigated by immigration from the surrounding woodland.
Reduce the area of occupancy of the Fawn Antechinus	Likely	The area of occupancy of the Fawn Antechinus will likely be reduced by less than 2 ha. This does not represent a significant proportion of suitable habitat in the local area.
Fragment an existing population of Fawn Antechinus into two or more populations	Unlikely	The proposed vent corridor is directly adjacent to the existing mine site and abuts the main access road to the site. It will therefore not fragment any fauna population or habitat.
Adversely affect habitat critical to the survival of Fawn Antechinus	Unlikely	Although the habitat to be cleared may be used by Fawn Antechinus, it is not highly suitable unburnt woodland, and is surrounded by other suitable habitat.
Disrupt the breeding cycle of a population of Fawn Antechinus	Possible	The species breeds from June to late August, if clearing takes place during this time period, disruption of the breeding cycle may take place on a very local scale within cleared areas.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the Fawn Antechinus is likely to decline	Unlikely	The area to be clear represents a small proportion of the habitat locally available.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the Fawn Antechinus habitat	Unlikely	Current operational pest management systems and procedures will apply to the development. It is highly unlikely that any pest that could impact Fawn Antechinus habitat will be introduced.
Introduce disease that may cause the Fawn Antechinus to decline	Unlikely	Current operational pest management systems and procedures will apply to the development. It is highly unlikely that any disease that could impact Fawn Antechinus habitat will be introduced.
Interfere with the recovery of the Fawn Antechinus	Unlikely	Any impact on the Fawn Antechinus is likely to be limited to short term local impacts with no flow on effects.

6.4 LISTED MIGRATORY SPECIES

6.4.1 Description

An assessment of the likelihood of each EPBC listed migratory species occurring within or near the proposed vent corridor was conducted. (Full details are available in Appendix C). Seven migratory bird species that breed within Australia, six migratory bird species that do not breed in Australia, and one reptile were rated as 'known' or 'likely' within the survey area (Table 27). The regional distribution and ecology of each species is discussed below with a consideration of the survey findings and assessment of the likelihood of potential impact.

6.4.2 Nature and Extent of Likely Impact

Species-specific assessments of impact significance addressing the significant impact criteria for EPBC Act Matters of National Environmental Significance Significant Impact Guidelines 1.1 (Commonwealth of Australia 2009), refined from those presented in the project referral are presented in Table format below.

Overall, the proposed development is considered unlikely to have a significant impact on any migratory species at a regional or national scale. The proposed disturbance involves clearing a small area (approximately 2 ha) within a substantially disturbed area previously used for "land application" disposal of excess water, and the subject of recent exploration clearing and drilling. Although some migratory species are known to occur in the proposed vent corridor and surrounds from time to time, the area contains habitat values rated mostly as poor to good, and there are substantial areas of high quality (rated excellent) habitat in the surrounding survey area (see section 5.4).

Table 27: Listed migratory species that are known or likely to occur in the vent corridor and surrounds

Common name	Likelihood of occurrence
Bird species	
Cattle Egret *Ardea ibis*	Known
Common Sandpiper *Actitis hypoleucos*	Known
Derby White-browed Robin *Poecilodryas superciliosa cerviniventris*	Likely
Eastern Great Egret *Ardea modesta*	Known
Marsh Sandpiper *Tringa stagnatilis*	Known
Melville Cicadabird *Coracina tenuirostris melvillensis*	Likely
Oriental Plover *Charadrius veredus*	Likely
Oriental Pratincole *Glareola maldivarum*	Likely
Rainbow Bee-eater *Merops ornatus*	Known
Rufous Fantail *Rhipidura rufifrons*	Likely
Terek Sandpiper *Xenus cinereus*	Likely
Whimbrel *Numenius phaeopus*	Known
White-bellied Sea-eagle *Haliaeetus leucogaster*	Known
Reptile Species	
Saltwater Crocodile *Crocodylus porosus*	Known

Cattle Egret (*Ardea ibis*)

The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Two major distributions have been located within Australia; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. In Western Australia and the Northern Territory, the Cattle Egret is located from Wyndham to Arnhem Land where it breeds in colonies (DoE 2013b). The species feeds on insects and small reptiles, amphibians and mammals (DoE 2013b). The major threats facing the Cattle Egret are persecution of large colonies in urban areas, loss of breeding habitats through wetland degradation and destruction, hunting, and in Australia, exotic species, especially feral cats (*Felis catus*) (DoE 2013b).

Table 28: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Cattle Egret using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Cattle Egret	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Cattle Egret.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Cattle Egret	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Cattle Egret habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Cattle Egret	Unlikely	The Cattle Egret is widespread and common across Australia and broadly distributed internationally. The proposed area of disturbance has not been identified as a key habitat for the species. No breeding sites have been identified on the RPA.

Common Sandpiper (*Actitis hypoleucos*)

The Common Sandpiper occurs throughout the Darwin and KNP regions of the NT as well as in WA and QLD. Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. More specifically, it is found within a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (DoE 2013b). The species breeds in Eurasia and moves south for the boreal winter, with the eastern breeding populations wintering in south Asia to Melanesia and Australia (DoE 2013b). In Australia, threats include: habitat loss, reduction of quality and quantity of water, global warming and such potential threats as disturbance from human activities i.e. fishing and aquaculture (DoE 2013b).

Table 29: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Common Sandpiper using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Common Sandpiper	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Common Sandpiper.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Common Sandpiper	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Common Sandpiper habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Common Sandpiper	Unlikely	Unlikely, as the Common Sandpiper is widespread along all coastlines of Australia, and broadly distributed internationally. The proposed area of disturbance has not been identified as a key habitat for the species. No breeding sites have been identified on the Ranger Project Area.

Derby White-browed Robin (Poecilodryas superciliosa cerviniventris)

The **Derby White-browed Robin** has a broad distribution across the northern NT (DoE 2013b). This species is found in woodlands, forests and wetlands (Birdlife International 2012). Known and perceived threats to the Derby White-browed Robin include agriculture, aquaculture, habitat alteration due to trampling and grazing by livestock, and predation, competition, habitat degradation and/or spread of pathogens by introduced species (DoE 2013b).

Table 30: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Derby White-browed Robin using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Derby White-browed Robin	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Derby White-browed Robin.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Derby White-browed Robin	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Derby White-browed Robin habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Derby White-browed Robin	Unlikely	The proposed area of disturbance has not been identified as a key habitat for the Derby White-browed Robin. No breeding sites have been identified on the Ranger Project.

Eastern Great Egret (*Ardea modesta*)

The Eastern Great Egret is widespread in Australia, occurring in all states and territories. In Australia, the largest breeding colonies, and greatest concentrations of breeding colonies, are located in near-coastal regions of the Top End of the NT. This species roosts in large flocks that may consist of hundreds of birds. The Great Egret has been reported in a wide range of wetland habitats (e.g. inland and coastal, freshwater and saline). In Australia, breeding sites are located in wooded and shrubby swamps including mangrove forests (the main habitat of the species in the Top End) (DoE 2013b). The Eastern Great Egret has a diverse diet that includes fish, insects, reptiles, small birds and mammals (DoE 2013b). In Australia, the Eastern Great Egret is threatened by loss and / or degradation of foraging and especially breeding habitat through alteration of water flows, drainage and / or clearing of wetlands for development, frequent burning of wetland vegetation used as nest sites, salinisation and invasion by exotic plants (DoE 2013b).

Table 31: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Eastern Great Egret using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Eastern Great Egret.	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Eastern Great Egret.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Eastern Great Egret.	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Eastern Great Egret habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Eastern Great Egret.	Unlikely	Unlikely as the project area has not been identified as a key habitat for the Eastern Great Egret.

Marsh Sandpiper (*Tringa stagnatilis*)

The marsh sandpiper is found on coastal and inland wetlands throughout Australia. The species is widespread in coastal Queensland, but few records exist north of Cooktown. There are scattered records in Western Australia and the Northern Territory. The species lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks (DoE 2013b). In north Australia, they prefer intertidal mudflats (Higgins & Davies 1996), although surveys in KNP recorded more birds around shallow freshwater lakes than in areas influenced by tide (Bamford 1988). In the Top End, they often use ephemeral pools on inundated freshwater and tidal floodplains (Higgins & Davies 1996). They are found infrequently around mangroves (DoE 2013b). They occur singly or in small to large flocks and are often associated with other waders and are often seen with Greenshanks, especially in salt fields. They may feed in tight coordinated groups, and sometimes feed with other wading birds (DoE 2013b). Threats within Australia include: habitat loss and degradation, disturbance and direct mortality (as a result of human activities such as wind farm construction) (DoE 2013b).

Table 32: Assessment of the likelihood of impacts of the clearing of native vegetation associated with the proposed development on the Marsh Sandpiper using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Marsh Sandpiper	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Marsh Sandpiper.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Marsh Sandpiper	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Marsh Sandpiper habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of Marsh Sandpiper	Unlikely	Unlikely, the Marsh Sandpiper widespread in Australia, and breeds from eastern Europe to eastern Siberia. The proposed area of disturbance has not been identified as a key habitat for the species.

Melville Cicadabird (Coracina tenuirostris melvillensis)

The Melville Cicadabird occurs in northern Australia from Broome in WA to the far eastern Top End. This species is a geographical variant of the Common Cicadabird (*Coracina tenuirostris*). These species use foliage in the canopy of diverse forests and woodlands, including mangroves and paperbark swamps. These species feed on insects and breed from September to June (peaking during November to February), building high nests below the canopy (Morecombe 2010). Known and perceived threats to the species include agriculture, aquaculture, land clearing, habitat fragmentation and habitat degradation (DoE 2013b).

Table 33: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Melville Cicadabird using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Melville Cicadabird	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Melville Cicadabird.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Melville Cicadabird	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could Melville Cicadabird habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Melville Cicadabird.	Unlikely	Unlikely as the proposed area of disturbance has not been identified as a key habitat for the Melville Cicadabird.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover is widely distributed across Australia in its winter period and is a non-breeding visitor to Australia during this time. The entire world population breeds in a restricted area centred on Mongolia and adjacent areas of south-eastern Siberia and north-eastern China. In Australia, the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia, and there are records at a few scattered sites elsewhere, mainly along the northern coast, such as in the Top End, the Gulf of Carpentaria and on Cape York Peninsula. The species often occurs further inland on the blacksoil plains of northern Western Australia, the Northern Territory and north-western Queensland. In the NT, there is an internationally important site for the Oriental Plover at Lake Sylvester. Of six sites in the NT which have been recognised as being of international importance for the species, none are in a conservation reserve, and two are in commercial saltworks (Bamford et al. 2008; Watkins 1993). Although there are no threats that apply specifically to Oriental Plovers, there are a number of threats that will affect all migratory waders. In Australia, the species occurs in sparsely-settled areas, and there are no immediate threats to its survival (Marchant and Higgins 1993). Little is known about the inland ephemeral wetlands that occur over vast areas of northern Australia, nor about the effects of grazing on this species' grassland habitat (Watkins 1993).

Table 34: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Oriental Plover using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Oriental Plover	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Oriental Plover.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Oriental Plover	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Oriental Plover habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Oriental Plover	Unlikely	Unlikely as the proposed area of disturbance has not been identified as a key habitat for the Oriental Plover.

Oriental Pratincole (*Glareola maldivarum*)

The Oriental Pratincole is widespread throughout Australia and in the northern areas, especially along the coasts of the Pilbara Region and the Kimberley Division in Western Australia, the Top End of the Northern Territory, and parts of the Gulf of Carpentaria. It is also widespread but scattered inland, mostly north of 20° S. The species has also been recorded on various outlying islands, including Lord Howe Island, and, in the Indian Ocean, Christmas Island and Cocos-Keeling Islands (Carter 1994; McAllan et al. 2004; Stokes et al. 1987). Within the NT, nationally important sites include: Lake De Burgh, Lake Woods and Lake Sylvester (DoE 2013b). Most birds are thought to spend the non-breeding season in Australia arriving between late October and early November and departing mid-March to early April (DoE 2013b). There are no published estimates of the extent of occurrence of the Oriental Pratincole in Australia although the area of occupancy of the Oriental Pratincole in Australia has been estimated at 10 000 km² (DoE 2013b). As the species mostly occurs within sparsely-settled areas, there are no immediate threats.

Table 35: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Oriental Pratincole using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Oriental Pratincole	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Oriental Pratincole.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for Oriental Pratincole	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Oriental Pratincole habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Oriental Pratincole	Unlikely	Unlikely as the proposed area of disturbance has not been identified as a key habitat for the Oriental Pratincole.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is distributed across much of mainland Australia, and occurs on several near-shore islands. The population size has not been determined but is assumed to be reasonably large based on reporting rates for the species. The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, various cleared or semi-cleared habitats or mangroves. Nests are constructed in an enlarged chamber at the end of long burrow or tunnel that is excavated, by both sexes 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 (DoE 2013b). The Rainbow Bee-eater mainly feeds on insects. The single identified threat to the Rainbow Bee-eater is the 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 (DoE 2013b).

Table 36: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Rainbow Bee-eater using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Rainbow Bee-eater	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Rainbow Bee-eater.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Rainbow Bee-eater	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Rainbow Bee-eater habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Rainbow Bee-eater	Unlikely	Unlikely, as the Rainbow Bee-eater is widespread across northern Australia. No breeding sites have been identified within the vent corridor.

Rufous Fantail (Rhipidura rufifrons)

The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia and has breeding populations occurring from about the South Australia-Victoria border, through to the Cairns-Atherton region, Queensland (DoE 2013b). The Rufous Fantail is considered a common and secure species (DoE 2013b). This species is usually seen singly or in pairs, but occasionally in small groups and in north and north-eastern Australia, they often occur in tropical rainforest and monsoon rainforests. The species breeds from approximately September to February. Rufous Fantails are insectivorous, foraging mainly in the low to middle strata of forests. The main threat to populations of 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 (DoE 2013b).

Table 37: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Rufous Fantail using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Rufous Fantail	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Rufous Fantail.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Rufous Fantail	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Rufous Fantail habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Rufous Fantail	Unlikely	Unlikely as the proposed area of disturbance has not been identified as a key habitat for the Rufous Fantail.

Terek Sandpiper (*Xenus cinereus*)

The Terek Sandpiper has a primarily coastal distribution, with occasional records inland. It is more widespread and common in northern and eastern Australia than southern Australia. In the NT, widespread records occur from Darwin, north to Melville Island, and east to the western section of the Gulf of Carpentaria, around Gove Peninsula, Groote Eylandt, Sir Edward Pellew Island and the mouth of the McArthur River. The species has also been recorded on Norfolk Island, Lord Howe Island and Christmas Island (DoE 2013b). Sites of international significance in the NT include: Chambers Bay, Fog Bay and adjacent islands and the Milingambi coast (SEWPaC 201). Mostly, the species forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons and has also been recorded on islets, mudbanks, sandbanks and spits, and near mangroves and occasionally in samphire (*Halosarcia* spp.) (DoE 2013b). Less often seen on sandy or shingle beaches, or on rock or coral reefs or platforms, Terek Sandpipers are occasionally sighted around drying sewage ponds and saltpans if surrounded by mudflats. The species is also found around brackish coastal swamps, lagoons and dune-lakes; and also on gravel or rocky edges of estuarine pools and freshwater river-pools (Marchant & Higgins 1993). Very occasionally, birds use swampy, grassy or cultivated paddocks near the coast (Marchant & Higgins 1993). Threats to the species include: habitat loss, disturbance and climate change with the greatest loss of birds being from both direct and indirect habitat loss (DoE 2013b).

Table 38: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Terek Sandpiper using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Terek Sandpiper	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Terek Sandpiper.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Terek Sandpiper	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact the habitat or the Terek Sandpiper will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Terek Sandpiper	Unlikely	Unlikely as the proposed area of disturbance has not been identified as a key habitat for the Terek Sandpiper.

Whimbrel (Numenius phaeopus)

The Whimbrel is a regular migrant to Australia (non-breeding in Australia) and New Zealand, with a primarily coastal distribution. There are also scattered inland records of the species in all regions. It is found in all states but is more common in the north. It has been found around the coasts of the Top End, where it sometimes follows rivers inland and is commonly widespread from Carnarvon to the north-east Kimberley Division, Western Australia. Some of the scattered records elsewhere include the species as a regular visitor to Norfolk Island, Lord Howe Island, Cocos-Keeling Island, Christmas Island, Kermadec Islands, Chatham Islands, Prince Edward Islands, Iles Crozet, and Ile de la Possession (Higgins & Davies 1996). There is one site of international significance within the NT (Chambers Bay) (DoE 2013b). The species is often found on the intertidal mudflats of sheltered coasts and is found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas. The species also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields (Higgins & Davies 1996). There are a small number of inland records from saline lakes and canegrass swamps (Jarman 1978). It has also been recorded in coastal dunes and on a football field (Smith & Chafer 1987). Whimbrels migrate southward to Australia to escape severe winter conditions and consequent high energy demand and low prey availability. Within Australia, threats come in the forms of: habitat loss (reduces the availability of foraging and roosting sites which in turn affect the birds' abilities to conserve energy required for successful migration and breeding) and degradation, disturbance and direct mortality (DoE 2013b).

Table 39: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Whimbrel using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Whimbrel	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Whimbrel.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Whimbrel	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Whimbrel habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Whimbrel	Unlikely	Highly unlikely, the Whimbrel is a regular migrant to Australia and NZ, with a primarily coastal distribution. The proposed area of disturbance has not been identified as a key habitat for Whimbrel.

White-bellied Sea-eagle (*Haliaeetus leucogaster*)

The White-bellied Sea-eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania and also extends inland along some of the larger waterways, especially in eastern Australia. Breeding records are patchily distributed, mainly along the coastline also, and especially the eastern coast, extending from Queensland to Victoria, and to Tasmania. This species is found in coastal habitats and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Breeding territories are located close to water, and mainly in tall open forest or woodland (DoE 2013b). The White-bellied Sea-eagle feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal. The main threats to the White-bellied Sea-eagle are loss of habitat due to land development, and disturbance of nesting pairs by human activity (DoE 2013b).

Table 40: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the White-bellied Sea-eagle using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the White-bellied Sea-eagle	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the White-bellied Sea-eagle.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the White-bellied Sea-eagle	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact White-bellied Sea-eagle habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the White-bellied Sea-eagle	Unlikely	Unlikely, as the species is widespread along all coastlines of Asia, Australia, and Oceania. It is not globally threatened; however declines in numbers have been recorded in Australia, Thailand and southeast Asia. A breeding site within the RPA has been observed at Georgetown Billabong, but will not be disturbed by construction activities.

Saltwater Crocodile (*Crocodylus porosus*)

The Saltwater Crocodile is a large member of the Crocodylidae Family and is found in Australian coastal waters, estuaries, freshwater sections of lakes, inland swamps and marshes. The species' distribution ranges from Rockhampton in Queensland throughout coastal NT to King Sound (near Broome) in Western Australia. In the NT, the Saltwater Crocodile has been found in many rivers including the Mary, Adelaide, Daly and Moyle Rivers (DoE 2013b). Preferred nesting habitat for the Saltwater Crocodile includes elevated isolated freshwater swamps that do not have the influence of tidal movements (DoE 2013b). The species feeds on crustaceans, insects and mammals. In Australia, threats to the Saltwater Crocodile include incidental mortality from fishing nets, habitat destruction, and in Arnhem Land, destruction of wetland habitat by feral animals such as pigs and buffalo (DoE 2013b).

Table 41: Assessment of the likelihood of potential impacts of the clearing of native vegetation associated with the proposed development on the Saltwater Crocodile using significant impact criteria developed by the Commonwealth of Australia (2009)

Significant impact criteria	Likelihood	Assessment
Substantially modify, destroy or isolate an area of important habitat for the Saltwater Crocodile	Unlikely	The removal of approximately 2 ha of disturbed habitat directly adjacent to the mine site is unlikely to negatively impact any habitat important for the Saltwater Crocodile.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Saltwater Crocodile	Unlikely	Current operational pest management systems and procedures will apply to the development. It is unlikely that any pest that could impact Saltwater Crocodile habitat will be introduced.
Seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Saltwater Crocodile	Unlikely	The Saltwater Crocodile is widespread across northern Australia. No breeding sites have been identified on the Ranger Project Area.

6.5 CONCLUSION

The proposed project area is approximately 2 km from the boundary of KNP, which is listed as a world heritage property, national heritage place, and wetland of international significance. The significance of any impacts of clearing and habitat fragmentation within the survey area has been assessed relative to the Commonwealth's significant impact guidelines (Commonwealth of Australia 2009) for each of Kakadu's significant values.

Due to its small scale, location within a highly disturbed area and close proximity to the existing mine, the clearing of native vegetation is considered highly unlikely to have a significant impact on any of the values associated with KNP's status as a world heritage place, national heritage place or wetland of international significance.

Significant impacts were assessed for listed fauna species recorded during the survey, and species that were considered in the desktop analysis as 'likely' or 'possible' within the survey area. There were no EPBC or TPWC listed plant species or threatened ecological communities assessed as likely to occur. A total of eight EPBC threatened and 14 EPBC migratory species were assessed. For each of these species the following impacts were considered unlikely or highly unlikely:

- long-term decrease in the area of occupancy, or population size or of an important population
- fragmentation of an important population
- adverse effects on critical habitat
- disruption of the breeding cycle of an important population
- modification, destruction, removal or reduction of availability or quality of habitat
- establishment of harmful invasive species, or disease.

Overall, the proposed clearing of approximately 2 ha of heavily impacted woodland is not considered likely to have significant impacts on the environmental values of KNP, or on listed threatened or migratory species.

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APPENDIX A: LIKELIHOOD ANALYSIS OF EPBC AND NT LISTED THREATENED FLORA SPECIES AND THREATENED ECOLOGICAL COMMUNITIES

Likelihood definitions:

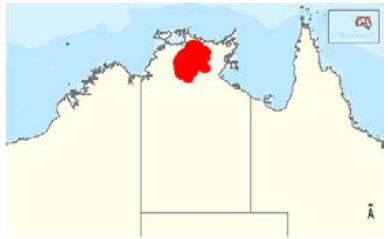
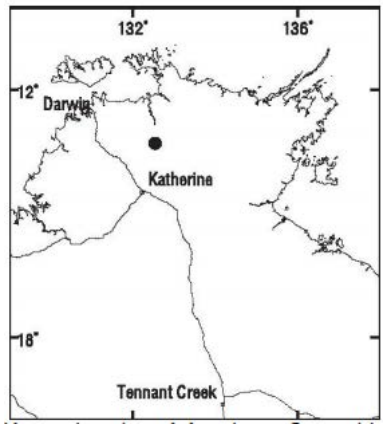
‘Known’ = the species has been recorded within the project area within the last decade.

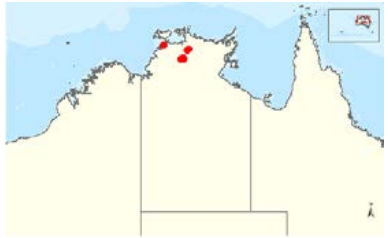
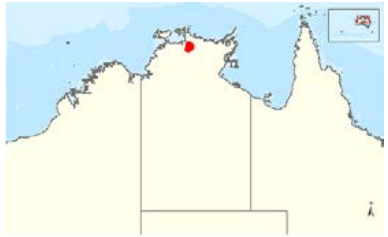
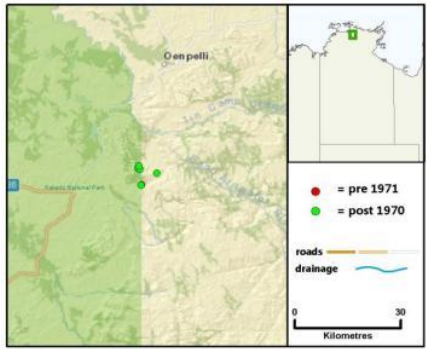
‘Likely’ = a medium to high probability that a species uses the survey area. The species has been recorded within the local area and habitat within the survey area is considered to be highly suitable.

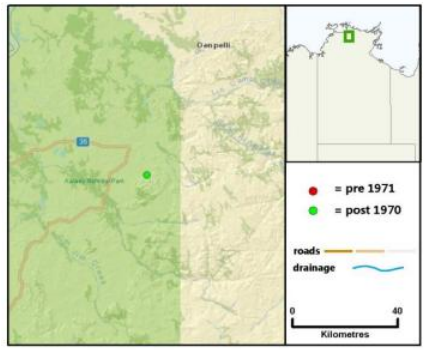
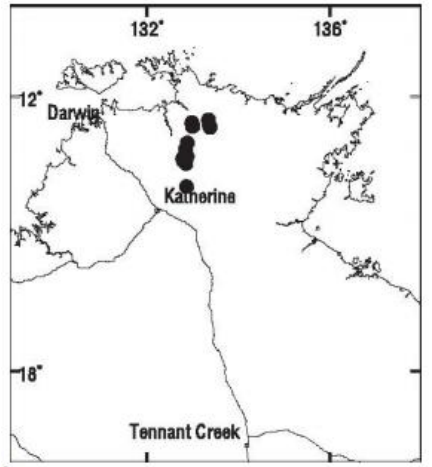
‘Possible’ = a medium to low probability that a species used the survey area. The species has been recorded within the local area or region and habitat within the survey area is considered to be moderately suitable. Species recorded in the area prior to recent population declines are included in this category.

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

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

Common name	EPBC and TPWC status	Likelihood of occurrence	Distribution map
Threatened ecological communities			
Arnhem Plateau Sandstone Shrubland Complex	Threatened ecological community	Highly unlikely. The community occurs primarily on the main Arnhem plateau massif, but also occurs on its outliers and is restricted to sandstone rock habitats including cervices and joints within pavements, and shallow sandsheets (DoE 2013b). Suitable sandstone habitat does not occur within the survey area.	 Source: DoE 2013b
Listed species			
Acacia sp. Graveside Gorge		Highly unlikely. This shrub inhabits sandstone in woodland with *Corymbia arnhemenis*, *Eucalyptus miniata/gigantangion*, *Templetonia hookeri* and *Triodia plectrachnoides* . An older record suggested the sandstone shrub '*Acacia* sp. Graveside Gorge' may occur five kilometres west of the survey area. This is likely to be incorrect since: a) it is only known from Graveside Gorge which is 77 km south of Jabiru; and b) the location does not match the species habitat requirements.	 Source: Kerrigan, Cowie and Brennan 2006

Common name	EPBC and TPWC status	Likelihood of occurrence	Distribution map
Hibiscus brennanii (a shrub)	EPBC and TPWC vulnerable	Highly unlikely. When listed, the species had only been recorded on sandstone cliff and gullies and on broken sandstone at Baroalba creek, on the Mt Brockman outliers of the Arnhem Land sandstone massif. In 2009 an individual was recorded in sandstone habitat on the main western Arnhem Land sandstone massif (DoE 2013b, Kerrigan and Cowie 2006a). The species has a highly restricted distribution and suitable sandstone habitat does not occur within the RPA.	 Source: DoE 2013b
Sauropus filicinus	EPBC vulnerable, TPWC data deficient	Highly unlikely. The species is restricted to crevices in sandstone cliffs and is known from seven locations on the Mt Brockman sandstone outlier and northern outliers in Kakadu national park, there is one record from the western Arnhem Land Plateau massif (Cowie and Kerrigan 2006). Suitable habitat for the species does not occur within the survey area.	 Source: DoE 2013b
Hibbertia brennanii	Vulnerable	Highly unlikely. Known from a single northern outlier of the west Arnhem Land escarpment. The species occurs in rock crevices in sandstone in cracks or pavement, in association with sandstone heath or Spinifex (Westaway and Cowie 2012a). The species has a very restricted distribution and suitable sandstone habitat does not occur within the survey area.	 Source Westaway and Cowie 2012a

Common name	EPBC and TPWC status	Likelihood of occurrence	Distribution map
Hibbertia tricornis	Vulnerable	Highly Unlikely. This species is only known from the Mt Brockman sandstone outlier (Westaway and Cowie 2012b). The species has a highly restricted distribution and suitable sandstone habitat does not occur with the survey area.	 Source Westaway and Cowie 2012b
Lithomyrtus linariifolia	Vulnerable	Highly unlikely. The species is known from Kakadu National Park and Arnhem land. Within the region, *Lithomyrtus linariifolia* occurs within heath and eucalypt woodland. The species is highly fire sensitive and occurs within fire protected pockets among sandstone boulders and outcrops (Kerrigan and Cowie 2006b). Habitat within the survey area is not suitable for this species.	 Source Kerrigan and Cowie 2006

APPENDIX B: LIKELIHOOD ANALYSIS OF EPBC AND NT LISTED THREATENED FAUNA SPECIES

*Likelihood definitions:

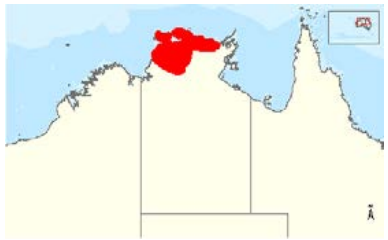
‘Known’ = the species has been recorded within the project area within the last decade.

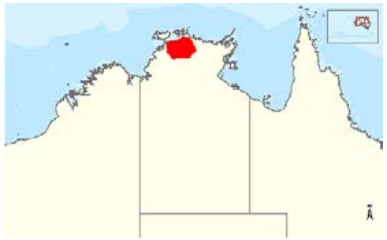
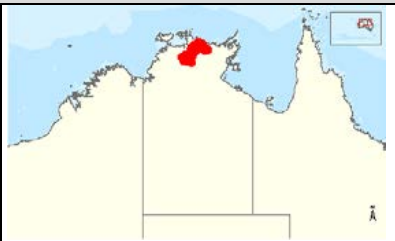
‘Likely’ = a medium to high probability that a species uses the site. The species has been recorded within the local area and habitat within the site is considered to be highly suitable.

‘Possible’ = a medium to low probability that a species used the site. The species has been recorded within the local area or region and habitat within the site is considered to be moderately suitable. Species recorded in the area prior to recent population declines are included in this category.

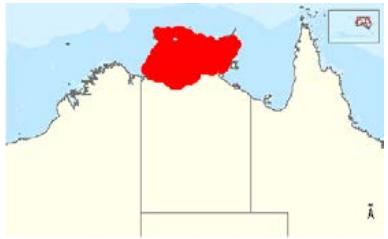
‘Unlikely’ = a very low to low probability that a species uses the site. The species may or may not occur locally or regionally, however based on the known habitat requirements of the species, and habitat available within the site, the site is considered unlikely to be suitable or marginal at best.

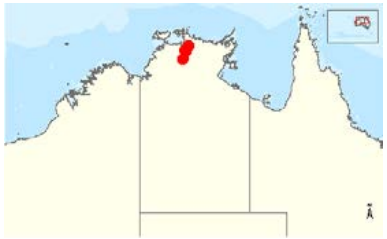
‘Highly unlikely’= habitat on site and in the vicinity is highly unsuitable for the species. Based on the known habitat requirements of the species, the site lacks the required habitat.

Common name	EPBC status	Likelihood of occurrence*	Distribution map (source DoE 2013b)
Bird species			
Eastern Partridge Pigeon (*Geophaps smithii smithii*)	Vulnerable	Known. Prefers primarily open forest and woodland habitat, which is present within site. The species has commonly been recorded within the project area (ENV Australia 2012) and was observed during this survey.	
Gouldian Finch (*Erythrura gouldiae*)	Endangered, migratory	Possible. Currently known to occur in significant numbers (> 50 adult birds) at only 10 locations, including five in Western Australia; and five in the Northern Territory. Inhabits open woodlands that are dominated by Eucalyptus trees and support a ground cover of Sorghum and other grasses. Critical components of suitable core habitat for the Gouldian Finch appear to be the presence of favoured annual and perennial grasses (especially Sorghum), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing Eucalyptus trees.	
Northern Masked Owl (*Tyto novaehollandiae kimberli*)	Vulnerable	Likely. Although the range of the species is poorly known, preferred habitat consists of riverine forest, rainforest, open forest, paperbark swamp and the edge of mangroves. The survey site is within the known range and includes area of suitable habitat.	

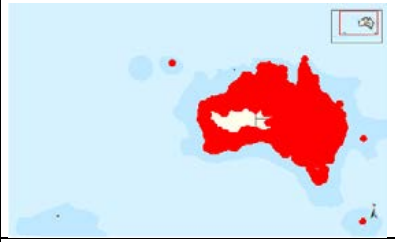
Common name	EPBC status	Likelihood of occurrence*	Distribution map (source DoE 2013b)
Red Goshawk (*Erythrotriorchis radiatus*)	Vulnerable	Likely. In the NT the Red Goshawk prefers tall open forest and woodland or tall fringing woodlands along rivers in grassland, shrub-lands, and low open woodlands. The survey area is within the known distribution.	
Yellow Chat (*Epthianura crocea tunneyi*)	Endangered	High unlikely. The Yellow Chat (Alligator Rivers) is endemic to the Northern Territory, where it has been recorded from Darwin to Oenpelli. The species occurs around channels and depressions on seasonally inundated floodplains. In the dry season the species contract into wetter areas of floodplains where it has been observed in areas of exposed mud or clay with or without a sparse cover of grasses, sedges and forbs. Breeding sites occur on levees in tidal rivers and channels. Suitable floodplain areas do not occur within the survey area.	
Mammal species			
Arnhem Land Rock-rat (*Zyzomys maini*)	Vulnerable	Unlikely. The Arnhem Rock-rat is endemic to the sandstone of western Arnhem Land, where it occurs in floristically rich monsoon vine thicket patches (DoE 2013b). This habitat is adjacent to but does not occur within the survey area.	

Common name	EPBC status	Likelihood of occurrence*	Distribution map (source DoE 2013b)
Bare-rumped Sheath-tailed Bat (*Saccolaimus saccolaimus nudicluniatus*)	Critically endangered	Likely. The distribution of this species is poorly understood, however, it has been infrequently recorded in floodplain areas of Kakadu National Park. There may be suitable habitat (*Pandanus* and *Eucalyptus* woodland) within the survey area.	
Brush-tailed Rabbit-rat (*Conilurus penicillatus*)	Vulnerable	Possible (formerly known). The species was formerly common in woodland in KNP but is thought to have declined to near extinction since the 1980s.	
Golden-backed Tree-rat (*Mesembriomys macrurus*)	Vulnerable	Possible. Small areas of suitable riverine habitat may be present within site, although the current distribution of the species is thought to be restricted to the coast of the north Kimberly (Palmer et al 2003).	

Common name	EPBC status	Likelihood of occurrence*	Distribution map (source DoE 2013b)
Golden Bandicoot (*Isoodon auratus auratus*)	Vulnerable	**Unlikely**. Although formerly widespread in hummock and tussock grasslands, *Acacia* and *Eucalyptus* woodlands, vine thickets and heath and woodlands across Northern Australia, the species is currently only known from the Wessel Islands group off north-east Arnhem Land Kimberly (Palmer et al 2003).	
Northern Brush-tailed Phascogale (*Phascogale pirata*)	Vulnerable	**Possible**. The species is restricted to *Eucalyptus tetrodonta* and *E. mineata* woodland in top end of the Northern Territory. This habitat makes up most of the survey area.	
Northern Quoll (*Dasyurus hallucatus*)	Endangered	**Possible (formerly known)**. Occupies a diversity of habitats across its range including rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert, but most common within 150 km of the coast (DoE 2013b). Northern Quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Rocky habitats are usually of high relief, often rugged and dissected but can also include tor fields or caves in low lying areas such as in Western Australia. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes.	

Common name	EPBC status	Likelihood of occurrence*	Distribution map (source DoE 2013b)
Reptile Species			
Arnhem Land Egernia (*Bellatorias obiri*)	Endangered	**Highly unlikely**. Largely restricted to sandstone outcrops, typically with extensive fissures and cave systems. These habitats do not occur within or near the survey area.	
Plains Death Adder (*Acanthophis hawkei*)	Vulnerable	**Highly unlikely**. This species is associated with cracking black soil plains habitat, which does not occur within or near the survey area.	

APPENDIX C: LIKELIHOOD ANALYSIS OF LISTED MIGRATORY SPECIES

Common name	EPBC status	Likelihood of occurrence	Distribution map (DoE 2013b)
Bird species			
Barn Swallow (*Hirundo rustica*)	Migratory	Possible. The species has a wide recorded distribution across northern Australia and prefers open country in coastal lowlands (usually near towns or cities) and freshwater wetlands, Melaleuca woodland, mesophyll shrub thickets and tussock grassland.	
Cattle Egret (*Ardea ibis*)	Migratory	Known. This species is a relatively small egret found in grasslands, woodlands and wetlands. The Cattle Egret is considered to be widespread and common. Breeding colonies have been observed in Arnhem Land, Northern Territory. The species has been recorded. The species has previously been recorded within the project area (ENV Australia 2012) and was observed during this survey.	
Common Sandpiper (*Actitis hypoleucos*)	Migratory	Known. In Australia, the Common Sandpiper is found in coastal or inland wetlands, both saline and fresh. It is found mainly on muddy edges or rocky shores. During the breeding season in the northern hemisphere, it prefers freshwater lakes and shallow rivers. The species has previously been recorded within the project area (ENV Australia 2012).	

Common name	EPBC status	Likelihood of occurrence	Distribution map (DoE 2013b)
Derby White-browed Robin (*Poecilodryas superciliosa cerviniventris*)	Migratory	Likely. The species has a wide recorded distribution across northern Australia. Sedentary species, known to inhabit mangroves, dense swamp vegetation, riparian vegetation and riverine woodland.	
Eastern Great Egret (*Ardea modesta*)	Migratory	Known. This species is widely distributed in Australia and is known to occur in habitat including wetlands, flooded pastures, dams, estuarine mudflats, mangroves and reefs. The species has previously been recorded within the project area (ENV Australia 2012) and was observed during this survey.	
Gouldian Finch (*Erythrura gouldiae*)	Endangered, migratory	Possible. Currently known to occur in significant numbers (> 50 adult birds) at only 10 locations, including five in Western Australia; and five in the Northern Territory. Inhabits open woodlands that are dominated by Eucalyptus trees and support a ground cover of Sorghum and other grasses. Critical components of suitable core habitat for the Gouldian Finch appear to be the presence of favoured annual and perennial grasses (especially Sorghum), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing Eucalyptus trees.	

Common name	EPBC status	Likelihood of occurrence	Distribution map (DoE 2013b)
Grey Plover (*Pluvialis squatarola*)	Migratory	Possible. The Grey Plover breeds around the Arctic regions and migrates to the southern hemisphere, being a regular summer migrant to Australia, mostly to the west and south coasts. It is generally sparse but not uncommon in some areas. The Grey Plover is almost entirely coastal, being found mainly on marine shores, inlets, estuaries and lagoons with large tidal mudflats or sandflats for feeding, sandy beaches for roosting, and also on rocky coasts.	
Marsh Sandpiper (*Tringa stagnatilis*)	Migratory	Known. Coastal. Occurs in permanent or ephemeral wetlands of varying degrees of salinity, and is commonly found inland. Breeds Eastern Europe to Eastern Siberia. Kakadu National Park is considered a site of national importance for the species, and it has been recorded in the Survey Area (ENV Australia 2012).	
Melville Cicadabird (*Coracina tenuirostris melvillensis*)	Migratory	Likely. The Melville Cicadabird occurs in Northern Australia from Broome in WA to the far eastern Top End. This species prefers diverse forests and woodlands, including mangroves and Melaleuca swamps.	

Common name	EPBC status	Likelihood of occurrence	Distribution map (DoE 2013b)
Oriental Plover (*Charadrius veredus*)	Migratory	Likely. recorded in all states but most common in coastal areas and northern Australia. The Oriental Plover is found generally inland; in open grasslands in arid and semi-arid zones; and less often in estuarine or littoral environments. This species prefers flat inland plains, sparsely vegetated short grass with hard bare ground including claypans, playing fields, lawns and cattle camps. It is a regular summer migrant to Australia from September to March.	
Oriental Pratincole (*Glareola maldivarum*)	Migratory	Likely. There is very limited information on this species. Breeds in Asia and Indochina. Outside of the breeding period, the species migrates to northern Australia where it inhabits open plains, bare ground around swamps, claypans and forages for insects.	
Rainbow Bee-eater (*Merops ornatus*)	Migratory	Known. This species is distributed across much of inland Australia and occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. In northern Australia it often inhabits mangroves. The species has commonly been recorded within the project area (ENV Australia 2012) and was observed during this survey.	
Rufous Fantail (*Rhipidura rufifrons*)	Migratory	Likely. The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia and is a common and secure species.	

Common name	EPBC status	Likelihood of occurrence	Distribution map (DoE 2013b)
Terek Sandpiper (*Xenus cinereus*)	Migratory	Likely. A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia. In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.	
Whimbrel (*Numenius phaeopus*)	Migratory	Known. Intertidal coastal mudflats, river deltas and mangroves, occasionally sandy beaches. Breeds Siberia and Alaska. The species has been recorded in the survey area (ENV Australia 2012).	
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)	Migratory	Known. Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas. Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away. The species has commonly been recorded within the project area (ENV Australia 2012) and was observed during this survey.	

Common name	EPBC status	Likelihood of occurrence	Distribution map (DoE 2013b)
Reptile Species			
Saltwater Crocodile (*Crocodylus porosus*)	Migratory	Known. This species is common in river systems throughout the Top End of the Northern Territory. The species has commonly been recorded within the project area (ENV Australia 2012) and was observed during this survey.	

APPENDIX D: FLORA SURVEY SITE DESCRIPTIONS

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
3	23	274650	8598132	*Sorghum* grassland	Isolated *Eucalyptus* trees with *Calytrix exstipulata* sparse shrubland in the midstorey and a dominant annual *Sorghum* sp. grassland in the understorey	U *Eucalyptus tetrodonta*, *Corymbia bleeseri*, *Xanthostemon paradoxus*\tree\7\bi	M ^*Calytrix exstipulata*, *Eucalyptus* sp. \shrub\4\r	G+ ^*Sorghum* sp., *Eriachne triseta* \grass\2\c
4	8	274626	8598175	*Corymbia* open woodland	*Corymbia bleeseri* open woodland with a mixed *Eucalyptus* species sparse shrubland in the midstorey and an annual *Sorghum* sp. sparse grassland in the understorey	U+ ^*Corymbia bleeseri*, *Xanthostemon paradoxus*\tree\7\r	M ^*Eucalyptus* spp., *Buchanania obovata*, *Jacksonia dilatata* \^shrub\4\r	^*Sorghum* sp., *Petalostigma quadrioculare*, *Eucalyptus* sp.\^grass, shrub\2\r
5	12	274643	8598072	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a mixed midstorey of *Acacia* and *Eucalyptus* species and annual *Sorghum* sparse grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Corymbia bleeseri*, *Eucalyptus miniata*\^tree\7\r	M *Eucalyptus* sp., *Acacia* sp., *Grevillea* sp.\shrub\4\r	^*Sorghum* sp., *Petalostigma quadrioculare*\^grass, shrub\2\r
6	12	274617	8597788	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Xanthostemon paradoxus* sparse shrubland in the midstorey and an *Eriachne triseta* open grassland in the understorey	U *Eucalyptus tetrodonta*, *Corymbia bleeseri*, *Xanthostemon paradoxus*, dead *Eucalyptus* sp.\^tree\7\r	M ^*Xanthostemon paradoxus*, *Acacia holosericea*, *Planchonia careya*\shrub\3\r	^*Eriachne triseta*, *Eriachne* sp.\grass\2\i
17	3	274695	8597575	*Acacia holosericea* shrubland	*Acacia holosericea* shrubland with an *Eriachne triseta* open grassland in the understorey		M+ ^*Acacia holosericea*, *Eucalyptus tetrodonta*, *Planchonia careya*\shrub\4\c	*Eriachne triseta*\grass\2\i
18	12	274717	8597511	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Acacia holosericea* open shrubland in the midstorey and a *Eriachne triseta* open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, dead *Eucalyptus* sp.\^tree\7\r	M ^*Acacia holosericea*, *Eucalyptus tetrodonta*\shrub\4\i	^*Eriachne triseta*, *Eucalyptus tetrodonta*, *Xanthostemon paradoxus*\^grass, shrub\2\i
19	12	274732	8597517	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Acacia holosericea* open shrubland in the midstorey and a *Eriachne triseta* open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, dead *Eucalyptus* sp.\^tree\7\r	M ^*Acacia holosericea*, *Eucalyptus tetrodonta*\shrub\4\i	^*Eriachne triseta*, *Eucalyptus tetrodonta*, *Xanthostemon paradoxus*\^grass, shrub\2\i
23	3	275138	8597796	*Acacia holosericea* shrubland	Isolated *Eucalyptus* trees with a dominant *Acacia holosericea* open shrubland in the midstorey and a *Heteropogon triticeus* grassland in the understorey	U ^*Eucalyptus tetrodonta*, dead trees\tree\7\bi	M+ ^*Acacia holosericea*, *Calytrix exstipulata*, *Eucalyptus* sp.\shrub\4\i	^ *Heteropogon triticeus*, *Eriachne triseta*, *Petalostigma quadrioculare*\grass\2\r
27	6	275178	8597782	*Acacia* shrubland	Isolated dead *Eucalyptus* trees with a dominant *Acacia oncinocarpa* shrubland in the midstorey and an annual *Sorghum* sparse grassland in the understorey	U ^Dead *Eucalyptus* sp.\tree\7\bi	M+ ^*Acacia oncinocarpa*, *Acacia holosericea*, *Eucalyptus tetrodonta*, *Eucalyptus miniata*\shrub\4\c	*Sorghum* sp., *Petalostigma quadrioculare*, *Calytrix exstipulata*, *Eriachne triseta*\grass, shrub\2\r
34	27	275337	8596591	*Melaleuca viridiflora* open woodland	*Melaleuca* low open woodland with a *Germainia truncatiglumis*, *Sorghum plumosum* grassland in the understorey	U+ *Melaleuca viridiflora*\tree\6\r		*Germainia truncatiglumis* , *Sorghum plumosum*, *Eriachne* sp.\grass\2\c
37	32	275543	8596782	Floodplain				
38	12	275654	8596825	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Pandanus spiralis* sparse shrubland in the midstorey an annual *Sorghum* sp. open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Planchonia careya*\tree\7\r	M *Pandanus spiralis*, *Erythrophleum chlorostachys*, *Planchonia careya*\palm, shrub\4\r	G+ ^*Sorghum* sp., *Eriachne triseta*, *Eucalyptus* sp.\grass\2\i
41	17	274671	8597654	*Eriachne triseta* grassland	Isolated *Corymbia bleeseri* and *Eucalyptus tetrodonta* trees with a mixed *Acacia holosericea* and *Eucalyptus* species midstorey and a dominant *Eriachne triseta* grassland in the understorey	U+ *Corymbia bleeseri*, *Eucalyptus tetrodonta*, *Planchonia careya*\tree\6\bi	M *Acacia holosericea*, *Eucalyptus* sp.\shrub\3\r	G+ *Eriachne triseta*, *Eriachne* sp.\grass\2\c

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
44	17	274729	8597725	*Eriachne triseta* grassland	Isolated *Eucalyptus tetrodonta*, *Corymbia bleeseri* trees with isolated *Acacia holosericea* shrubs in the midstorey and a dominant *Eriachne triseta* grassland in the understorey	U *Eucalyptus tetrodonta*, *Corymbia bleeseri*\tree\7\bi	M *Acacia holosericea*, *Flagellaria indica* \^shrub, vine\3\bi	G+ *Eriachne triseta*\grass\2\c
52	28	275543	8596753	*Melaleuca viridiflora* shrubland	*Melaleuca viridiflora* shrubland with a *Germainia truncatiglumis* grassland in the understorey		M *Melaleuca viridiflora*, *Melaleuca dealbata*, *Melaleuca* sp.\shrub\4\c	*Germainia truncatiglumis*, *Sorghum plumosum*, *Eriachne triseta*\grass\2\c
53	26	275522	8596771	*Melaleuca viridiflora* open forest	*Melaleuca viridiflora* open forest with a *Germainia truncatiglumis* grassland in the understorey	U+ *Melaleuca viridiflora*\tree\7\c		*Germainia truncatiglumis*\grass\2\c
64	17	275728	8596962	*Eriachne triseta* grassland	Isolated *Melaleuca cajeputi* trees with a *Eriachne triseta* grassland in the understorey	U *Melaleuca cajeputi*\tree\6\bi		G+ *Eriachne triseta*\grass\1\c
71	30	275183	8598312	Mixed Riparian - Braided Channel	*Melaleuca viridiflora* open forest with a *Germainia truncatiglumis* sparse grassland in the understorey	U+ *Melaleuca viridiflora*\tree\7\c		*Germainia truncatiglumis*\grass\2\r
75	12	274849	8597364	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Calytrix exstipulata* tall open shrubland and a *Eriachne triseta* open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Corymbia porrecta*\^tree\7\r	M ^*Calytrix exstipulata*, *Xanthostemon paradoxus*, *Acacia mimula*\shrub\4\i	^*Eriachne triseta*, *Calytrix exstipulata*, *Xanthostemon paradoxus*\^grass, shrub\2\i
79	7	274694	8598032	Dead *Acacia* open shrubland	Isolated dead *Eucalyptus* sp. trees with a dominant dead *Acacia* sp. Open shrubland in the midstorey and a *Eriachne triseta* open grassland in the understorey	U Dead *Eucalyptus* sp.\tree\7\bi	M+ ^Dead *Acacia* sp., *Acacia holosericea*, *Xanthostemon paradoxus*, *Eucalyptus tetrodonta*\shrub\4\i	G *Eriachne triseta*, *Ectrosia leporina*, *Dicanthium* Tansect A\grass\2\i
84	12	274660	8597994	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus tetrodonta* open shrubland and a *Eriachne triseta* open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Xanthostemon paradoxus*\tree\7\r	M ^*Eucalyptus tetrodonta*, *Xanthostemon paradoxus*, *Planchonia careya*\^shrub\4\i	^*Eriachne triseta*, *Sorghum* sp.\grass\2\i
89	19	275746	8597923	Grassland	Isolated *Melaleuca viridiflora* trees with isolated *Pandanus spiralis* palms in the midstorey and a Grass sp. Grassland understorey	U+ *Melaleuca viridiflora*, *Corymbia polycarpa*\tree\7\bi	M *Pandanus spiralis*\palm\4\bi	Grass sp.\grass\2\c
95	12	275809	8597174	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland	U+ ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*\^tree\7\r		
98	30	275740	8596975	Mixed Riparian - Braided Channel	*Melaleuca cajeputi* open woodland with a Grass sp. open grassland in the understorey	U+ *Melaleuca cajeputi*\tree\6\r		Grass sp.\grass\2\i
103	8	275449	8597202	*Corymbia* open woodland	*Corymbia foelscheana* open woodland with a mixed dead *Acacia* sp. *Pandanus spiralis*, *Buchanania obovata* sparse shrubland and a *Eriachne triseta* open grassland in the understorey	U+ *Corymbia foelscheana*, *Wrightii saligna*\tree\7\r	M Dead *Acacia*, *Pandanus spiralis*, *Buchanania obovata*, *Petalostigma pubescens*\shrub\4\r	^*Eriachne triseta*, *Sorghum* sp., *Pandanus spiralis*\grass\2\i
110	19	274907	8598582	Grassland				
112	26	275749	8596994	*Melaleuca viridiflora* open forest	*Melaleuca viridiflora* open forest	U+ *Melaleuca viridiflora*\tree\7\c		
120	9	275535	8597558	*Corymbia polycarpa* open woodland	*Corymbia polycarpa* open woodland with a *Germainia truncatiglumis*, *Mnesithia rottboellioides* grassland understorey	U+ ^*Corymbia polycarpa*, *Melaleuca cajeputi*, *Terminalia erythrocarpa*, *Eucalyptus alba*\tree7\r		*Germainia truncatiglumis*, *Mnesithia rottboellioides*\grass\2\c

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
122	22	274015	8598342	*Pseudoraphis spinescens* closed grassland	*Pseudoraphis spinescens* closed grassland			G+ ^*Pseudoraphis spinescens*, *Persicaria attenuata*\grass\forb\1\d
123	30	274126	8598340	Mixed Riparian - Braided Channel	Mixed *Acacia lacertensis*, *Grevillea pteridifolia*, *Acacia difficilis* sparse shrubland with an *Eriachne triseta* sparse grassland in the understorey		*Acacia lacertensis*, *Grevillea pteridifolia*, *Acacia difficilis*\shrub\4\r	^*Eriachne triseta*, *Sorghum* sp., *Pandanus spiralis*\grass\2\r
127	30	274083	8598581	Mixed Riparian - Braided Channel	Isolated *Lophostemon grandiflorus* trees with a *Asteromyrtus symphyocarpa* sparse shrubland in the midstorey and a *Germainia truncatiglumis* closed grassland in the understorey	U *Lophostemon grandiflorus*\tree\7\bi	M+ *Asteromyrtus symphyocarpa*\shrub\r	^*Germainia truncatiglumis*, *Melaleuca viridiflora*\^grass, shrub\2\d
128	20	275006	8597354	*Heteropogon triticeus* open grassland	Isolated *Eucalyptus tetrodonta*, dead trees, *Xanthostemon paradoxus* trees with a mixed *Xanthostemon paradoxus*, *Corymbia dunlopiana*, *Eucalyptus tetrodonta* sparse shrubland in the midstorey and a *Heteropogon triticeus* open grassland	U *Eucalyptus tetrodonta*, dead trees, *Xanthostemon paradoxus*\tree\7\bi	M+ *Xanthostemon paradoxus*, *Corymbia dunlopiana*, *Eucalyptus tetrodonta*\shrub\3\r	*Heteropogon triticeus*\grass\2\i
129	21	274985	8597333	*Heteropogon triticeus* sparse grassland	Isolated *Corymbia dunlopiana* shrubs with a *Heteropogon* mid sparse grassland		M+ ^*Corymbia dunlopiana*, *Xanthostemon paradoxus*, *Eucalyptus tetrodonta*\shrub\3\bi	^*Heteropogon triticeus*, *Eucalyptus* sp.\grass, shrub\2\r
130	21	274985	8597333	*Heteropogon triticeus* sparse grassland	Isolated *Corymbia dunlopiana* shrubs with a *Heteropogon* mid sparse grassland		M+ ^*Corymbia dunlopiana*, *Xanthostemon paradoxus*, *Eucalyptus tetrodonta*\shrub\4\bi	^*Heteropogon triticeus*, *Eucalyptus* sp.\grass, shrub\2\r
135	13	275845	8597141	*Eucalyptus tetrodonta* woodland	*Eucalyptus tetrodonta* woodland with a mixed *Persoonia falcata*, *Pandanus spiralis*, *Planchonia careya* sparse shrubland in the midstorey and an annual *Sorghum* sp. mid sparse grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Erythrophleum chlorostachys*\tree\7\i	M *Persoonia falcata*, *Pandanus spiralis*, *Planchonia careya*\palm, shrub\4\r	*Sorghum* sp.\grass\2\r
144	25	275129	8598309	*Melaleuca argentea* open woodland/woodland	*Melaleuca argentea* woodland	U+ ^*Melaleuca argentea*, *Syzygium forte*, *Syzygium armstrongii* \tree\7\i		
148	29	275320	8597072	*Melaleuca viridiflora* woodland	*Melaleuca viridiflora* woodland with a *Melaleuca viridiflora*, *Pandanus spiralis* sparse shrubland in the midstorey and *Eriachne triseta* open grassland in the understorey	U+ ^*Melaleuca viridiflora*, *Lophostemon grandiflora*\tree\7\i	M *Melaleuca viridiflora*, *Pandanus spiralis* \shrub\4\r	^*Eriachne triseta*, Mnesithia *rottboellioides*, *Cyperus* ? *javanicus*\^grass\2\i
157	11	274735	8598013	*Eucalyptus* shrubland	Isolated dead *Eucalyptus* sp. trees with a dominant *Eucalyptus tetrodonta*, dead *Acacia* sp. shrubland in the midstorey	U ^Dead *Eucalyptus* sp.\tree\7\bi	M+ ^*Eucalyptus tetrodonta*, dead *Acacia* sp.\^shrub\4\c	
1_1	30	274783	8598208	Mixed Riparian - Braided Channel	*Melaleuca viridiflora*, *Eucalyptus alba* woodland with *Acacia lacertensis*, *Pandanus spiralis*, *Acacia holosericea* sparse shrubland in the midstorey and a *Leptocarpus spathaceus*, *Eriachne triseta*, *Mnesithia rottboellioides* sparse grassland in the understorey	U+ *Melaleuca viridiflora*, *Eucalyptus alba*\tree\7\i	M *Acacia lacertensis*, *Pandanus spiralis*, *Acacia holosericea*\shrub, palm\4\r	*Leptocarpus spathaceus*, *Eriachne triseta*, *Mnesithia rottboellioides*\sedge, grass\2\r
10_1	11	274906	8597791	*Eucalyptus* shrubland	Isolated dead *Eucalyptus* trees with a dominant *Eucalyptus tetrodonta* shrubland in the midstorey	U ^Dead *Eucalyptus* sp.\tree\7\bi	M+ ^*Eucalyptus tetrodonta*, dead *Acacia* sp.\^shrub\4\c	
100_1	8	275296	8597395	*Corymbia* open woodland	*Corymbia latifolia* open woodland with a *Corymbia latifolia*, *Planchonia careya*, *Hakea arborescens* sparse shrubland midstorey and an annual *Sorghum* sp. open grassland in the understorey	U+ ^*Corymbia latifolia*, *Wrightii saligna*, *Corymbia porrecta*\tree\7\r	M *Corymbia latifolia*, *Planchonia careya*, *Hakea* arborescens\tree, shrub\3\r	*Sorghum* sp., *Buchanania obovata*, *Corymbia latifolia*\^grass, shrub\2\i

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
101_1	12	275151	8597509	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta*, *Corymbia bleeseri*, dead *Eucalyptus* sp. open woodland with a *Calytrix exstipulata* open shrubland and an annual *Sorghum* sp. open grassland understorey	U *Eucalyptus tetrodonta*, *Corymbia bleeseri*, dead *Eucalyptus* sp.\^tree\7\r	M+ ^*Calytrix exstipulata*, *Xanthostemon paradoxus*, *Acacia mimula*\shrub\4\i	^*Sorghum* sp., *Petalostigma quadrioculare*, *Eucalyptus* sp.\grass, shrub\2\i
102_1	12	275432	8597227	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Wrightii saligna*, *Cochlospermum fraseri*, *Acacia hemignosta* sparse shrubland in the midstorey and an annual *Sorghum* sp. open grassland understorey	U+ ^*Eucalyptus tetrodonta*, *Corymbia dysjuncta*\^tree\7\r	M *Wrightii saligna*, *Cochlospermum fraseri*, *Acacia hemignosta*\shrub\4\r	*Sorghum* sp., *Acacia hemignosta*, *Petalostigma quadrioculare*\grass, shrub\2\i
105_1	8	275484	8597023	*Corymbia* open woodland	*Corymbia latifolia* open woodland with a *Hakea arborescens* open shrubland midstorey and a *Heteropogon triticeus* grassland understorey	U+ ^*Corymbia latifolia*, *Eucalyptus* sp.\tree\7\r	M ^*Hakea* arborescens, *Terminalia canescens*\shrub\4\i	^ *Heteropogon triticeus*, *Eriachne triseta*, Grass sp.\grass\2\c
106_1	18	275160	8596763	*Eriachne triseta* open grassland	*Eriachne triseta* open grassland			*Eriachne triseta*\grass\2\i
134_1	23	274674	8598143	*Sorghum* grassland	Isolated *Eucalyptus tetrodonta*, *Corymbia bleeseri* trees with dead *Acacia* sp. isolated shrubs in the midstorey and a dominant annual *Sorghum* sp. grassland understorey	U *Eucalyptus tetrodonta*, *Corymbia bleeseri*\tree\7\bi	M ^Dead *Acacia* sp., *Xanthostemon paradoxus*, *Eucalyptus* sp.\shrub\3\bi	G+ ^*Sorghum* sp., *Eriachne triseta* \grass\2\c
14_1	12	274552	8598028	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Calytrix exstipulata* open shrubland in the midstorey and an annual *Sorghum* sp. grassland understorey	U+ ^*Eucalyptus tetrodonta*, *Corymbia dysjuncta*, dead trees\^tree\7\r	M+ ^*Calytrix exstipulata*, *Eucalyptus* sp., *Planchonia careya*\shrub\4\i	^*Sorghum* sp., *Petalostigma quadrioculare*, *Eucalyptus* sp.\^grass, shrub\2\c
14_2	26	274463	8598096	*Melaleuca viridiflora* open forest	*Melaleuca viridiflora* open forest with isolated *Pandanus spiralis* palms in the midstorey and a Grass sp. sparse grassland understorey	U+ ^ *Melaleuca viridiflora*, *Melaleuca cajeputi*\tree\7\ c	M *Pandanus spiralis*, *Grevillea pteridifolia*\palm, tree\4\bi	^ Grass sp., *Melaleuca viridiflora*\^grass, shrub\2\r
144_1A	25	274854	8598295	*Melaleuca argentea* open woodland/woodland	*Melaleuca argentea* open woodland with *Pandanus spiralis* sparse shrubland in the midstorey and Grass sp. sparse grassland understorey	U+ ^*Melaleuca argentea*, *Syzygium forte* \tree\7\r	M *Pandanus spiralis*, *Syzygium armstrongii*, *Asteromyrtus symphyocarpa*\palm, shrub\4\r	Grass sp., *Ectrosia leporina*\grass\2\r
144_1B	25	275555	8597639	*Melaleuca argentea* open woodland/woodland	*Melaleuca argentea* open woodland	U+ ^*Melaleuca argentea*, *Melaleuca viridiflora*\tree\7\r		
144_2	25	275490	8597664	*Melaleuca argentea* open woodland/woodland	*Melaleuca argentea* woodland	U+ ^*Melaleuca argentea*\tree\7\i		
148_1	30	275963	8597224	Mixed Riparian - Braided Channel	*Melaleuca viridiflora* open forest	U+ *Melaleuca viridiflora*\tree\6\c		
148_2	29	275538	8597596	*Melaleuca viridiflora* woodland	*Melaleuca viridiflora* open forests with a *Germainia truncatiglumis* grassland understorey	U+ *Melaleuca viridiflora*\tree\7\c		*Germainia truncatiglumis*\grass\2\c
149_1	13	275096	8597980	*Eucalyptus tetrodonta* woodland	*Eucalyptus tetrodonta* woodland with a *Eucalyptus tetrodonta* sparse shrubland in the midstorey and a mixed *Heteropogon triticeus*, *Pseudopogonatherum* sp., *Petalostigma quadrioculare* sparse grassland understorey	U ^*Eucalyptus tetrodonta*, dead *Eucalypt*\^tree\7\i	M ^*Eucalyptus tetrodonta*, *Xanthostemon paradoxus*, *Planchonia careya*, dead *Acacia*\^shrub\4\r	*Heteropogon triticeus*, *Pseudopogonatherum* sp., *Petalostigma quadrioculare*\^grass, shrub\2\r
2_1	13	274426	8598145	*Eucalyptus tetrodonta* woodland	*Eucalyptus tetrodonta* woodland with an Alphitonia excelsa sparse shrubland in the midstorey and an annual *Sorghum* sp. Grassland understorey	U+ ^*Eucalyptus tetrodonta*, *Xanthostemon paradoxus*, dead *Eucalyptus* sp., *Wrightii saligna*\^tree\7\i	M ^Alphitonia excelsa, *Petalostigma pubescens*, *Syzygium suboriculare*, *Acacia dimidiata*\shrub\3\r	^*Sorghum* sp., *Eucalyptus* sp.\^grass, shrub\2\c

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
20_1	2	274791	8597455	*Acacia holosericea* open shrubland	Isolated *Eucalyptus tetrodonta* trees with a *Acacia holosericea* open shrubland in the midstorey and a *Heteropogon triticeus* open grassland understorey	U *Eucalyptus tetrodonta*\tree\7\bi	M+ ^*Acacia holosericea*, *Calytrix exstipulata*, *Xanthostemon paradoxus*\shrub\4\i	^ *Heteropogon triticeus*, *Eriachne triseta*\grass\2\i
21_1	12	274893	8597452	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Acacia holosericea* open shrubland in the midstorey and an *Eriachne triseta* open grassland	U+ ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Corymbia porrecta*\^tree\7\r	M ^*Acacia holosericea*, *Xanthostemon paradoxus*\shrub\4\i	^*Eriachne triseta*, *Heteropogon triticeus*\grass\3\i
22_1	12	274831	8597412	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Acacia holosericea* open shrubland in the midstorey and a *Heteropogon triticeus* sparse grassland	U+ ^*Eucalyptus tetrodonta*\tree\7\r	M ^*Acacia holosericea*, *Calytrix exstipulata*, *Xanthostemon paradoxus*\shrub\4\i	^ *Heteropogon triticeus*, *Eriachne triseta*\grass\2\r
26_1	12	274966	8597175	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus* sp. sparse shrubland in the midstorey and a *Heteropogon triticeus* open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*\^tree\7\r	M ^*Eucalyptus* spp. \^shrub\4\r	^ *Heteropogon triticeus*, *Eucalyptus* sp.\^grass, shrub\2\i
29_1	13	275004	8596996	*Eucalyptus tetrodonta* woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus tetrodonta* open shrubland in the midstorey and a *Heteropogon triticeus* grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Corymbia bleeseri*, *Eucalyptus miniata*\^tree\7\i	M ^*Eucalyptus tetrodonta*, *Planchonia careya*, *Eucalyptus* spp.\^shrub\4\r	^*Heteropogon triticeus*, *Petalostigma quadrioculare*, *Eriachne triseta*\^grass, shrub\2\r
3 new	4	275259	8597151	*Acacia holosericea* sparse shrubland	*Acacia holosericea* sparse shrubland		M+ ^*Acacia holosericea*, *Calytrix exstipulata*\shrub\3\ir	
30_1	12	275216	8597009	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus* sp. sparse shrubland in the midstorey and an annual *Sorghum* sp. open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, Dead *Eucalyptus*, *Corymbia bleeseri*, *Eucalyptus miniata*\^tree\7\r	M ^*Eucalyptus* sp., *Xanthostemon paradoxus*, *Acacia mimula*\^shrub\4\r	^*Eucalyptus* sp., *Sorghum* sp., *Petalostigma quadrioculare*, *Acacia mimula*\^shrub, grass\2\i
31_1	12	275208	8596856	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus* sp. sparse shrubland in the midstorey and an annual *Sorghum* sp. open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, Dead *Eucalyptus*, *Corymbia bleeseri*, *Eucalyptus miniata*\^tree\7\r	M ^*Eucalyptus* sp., *Xanthostemon paradoxus*, *Acacia mimula*\^shrub\4\r	^*Eucalyptus* sp., *Sorghum* sp., *Petalostigma quadrioculare*, *Acacia mimula*\^shrub, grass\2\i
31_2	12	275239	8596932	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus tetrodonta* sparse shrubland in the midstorey and an annual *Sorghum* sp. open grassland understorey	U+ ^*Eucalyptus tetrodonta*, Dead *Eucalyptus*, *Corymbia bleeseri*, *Eucalyptus miniata*\^tree\7\r	M ^*Eucalyptus* sp., *Xanthostemon paradoxus*, *Acacia mimula*\^shrub\4\r	^*Eucalyptus* sp., *Sorghum* sp., *Petalostigma quadrioculare*, *Acacia mimula*\^shrub, grass\2\i
31_5	12	275318	8597075	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus tetrodonta* sparse shrubland in the midstorey and an annual *Sorghum* sp. open grassland understorey	U+ ^*Eucalyptus tetrodonta*\^tree\7\r	M ^*Eucalyptus* sp., *Xanthostemon paradoxus*\^shrub\4\r	^*Sorghum* sp., *Eriachne triseta*, *Calytrix exstipulata* \grass\2\i
37_2	32	275475	8596778	Georgetown Billabong Fringe	*Eleocharis dulcis* sedgeland			
39_1	13	274867	8597321	*Eucalyptus tetrodonta* woodland	*Eucalyptus tetrodonta* open woodland with an *Acacia mimula* open shrubland in the midstorey and an *Eriachne triseta* open grassland in the understorey	U ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*, dead *Eucalypt*\^tree\7\i	M ^*Acacia mimula*, *Calytrix exstipulata*, *Acacia holosericea*\shrub\4\i	^*Eriachne triseta*, *Petalostigma quadrioculare*, shrub 1\^grass, shrub\2\i
39_2	5	274761	8597447	*Acacia* open shrubland	*Acacia holosericea* open shrubland with a *Eriachne triseta* open grassland understorey		M+ *Acacia holosericea*, *Acacia lacertensis*, *Calytrix exstipulata*\shrub\4\i	^*Eriachne triseta*, *Melinis repens*\grass, shrub\2\i
39_3	8	274740	8597470	*Corymbia* open woodland	*Corymbia* dysjuncta open woodland with a mixed *Acacia holosericea*, *Acacia hemignosta* sparse shrubland in the midstorey and *Calytrix exstipulata* shrubland in the understorey	U+ ^*Corymbia* dysjuncta\tree\7\r	M *Acacia holosericea*, *Acacia hemignosta*\shrub\4\r	^*Calytrix exstipulata*, *Eriachne triseta*\shrub\3\c

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
4 new	12	274982	8597403	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus tetrodonta* open shrubland in the midstorey and a *Heteropogon triticeus* sparse grassland in the understorey	U+ ^*Eucalyptus tetrodonta*\^tree\7\r	M ^*Eucalyptus tetrodonta*, *Acacia holosericea*, *Xanthostemon paradoxus*\^shrub\4\i	*Heteropogon triticeus*\grass\2\r
40_1	13	274939	8597059	*Eucalyptus tetrodonta* woodland	*Eucalyptus tetrodonta* open woodland with an *Acacia difficilis* open shrubland in the midstorey and a *Heteropogon triticeus* open grassland in the understorey	U+ ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*\^tree\7\i	M ^*Acacia difficilis*, *Acacia hemignosta*, *Acacia holosericea*\shrub\4\i	^ *Heteropogon triticeus*, *Eucalyptus* sp.\^grass, shrub\2\i
5 new	15	275008	8597396	*Xanthostemon paradoxus* open shrubland	Isolated Eucalyptus *tetrodonta* trees with a dominant *Xanthostemon paradoxus* open shrubland and an *Eriachne triseta* sparse grassland understorey	U *Eucalyptus tetrodonta*, *Corymbia porrecta*\tree\7\bi	M+ ^*Xanthostemon paradoxus*, *Calytrix exstipulata*, *Acacia holosericea*\shrub\4\i	^*Eriachne triseta*, *Heteropogon triticeus*\grass\2\r
6_1	12	274683	8597975	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Eucalyptus tetrodonta* open shrubland in the midstorey and an *Eriachne triseta* open grassland understorey	U ^*Eucalyptus tetrodonta*, *Corymbia bleeseri*, dead *Eucalypt*\^tree\7\r	M+ ^*Eucalyptus tetrodonta*, *Xanthostemon paradoxus*, *Corymbia bleeseri*\^shrub\4\i	*Eucalyptus tetrodonta*, *Xanthostemon paradoxus*, *Eriachne triseta*\^shrub, grass\2\i
68_1	30	275593	8597884	Mixed Riparian - Braided Channel	*Eucalyptus alba* open woodland with a mixed *Acacia* sp., *Carallia brachiata*, *Melaleuca viridiflora* shrubland in the midstorey and *Mnesithia rottboellioides* grassland understorey	U+ ^*Eucalyptus alba*, *Corymbia polycarpa*, *Melaleuca viridiflora*\tree7\r	M *Acacia* sp., *Carallia brachiata*, *Melaleuca viridiflora*\shrub\4\c	*Mnesithia rottboellioides*\grass\2\c
68_3	30	275565	8597835	Mixed Riparian - Braided Channel	Isolated *Eucalyptus alba* trees with a *Acacia holosericea*, *Eucalyptus* sp. sparse shrubland in the midstorey and a *Mnesithia rottboellioides* grassland understorey	U+ ^*Eucalyptus alba*, *Corymbia polycarpa*\tree7\bi	M *Acacia holosericea*, *Eucalyptus* sp.\shrub\4\r	U +*Mnesithia rottboellioides*\grass\2\c
69_1	30	275532	8597714	Mixed Riparian - Braided Channel	*Melaleuca viridiflora*, *Eucalyptus alba* open forest with a *Mnesithia rottboellioides* grassland understorey	U+ *Melaleuca viridiflora*, *Eucalyptus alba*\tree\7\c		*Mnesithia rottboellioides*, *Germainia truncatiglumis*\grass\2\c
7 new	33	274548	8598055	*Calytrix* open shrubland	*Calytrix exstipulata* open shrubland with an annual *Sorghum* sp. grassland understorey		M ^*Calytrix exstipulata*\shrub\3\i	^*Sorghum* sp.\grass\2\c
71_1A	30	274485	8598518	Mixed Riparian - Braided Channel	*Melaleuca viridiflora* open forests with a *Melaleuca viridiflora* shrubland in the midstorey and *Germainia truncatiglumis* grassland understorey	U+ *Melaleuca viridiflora*, *Eucalyptus alba*\tree\7\c	M *Melaleuca viridiflora* \shrub\4\c	*Germainia truncatiglumis*\grass\2\c
71_1B	30	274911	8598568	Mixed Riparian - Braided Channel	*Melaleuca viridiflora* open forests with a mixed *Pandanus spiralis*, *Syzygium armstrongii*, *Syzygium forte* sparse shrubland in the midstorey and	U+ *Melaleuca viridiflora*, *Eucalyptus alba*\tree\7\c	M *Pandanus spiralis*, *Syzygium armstrongii*, *Syzygium forte*\palm, shrub\3\r	
71_1C	30	274974	8598502	Mixed Riparian - Braided Channel	*Melaleuca viridiflora* woodland with a mixed dead *Acacia*, *Pandanus spiralis*, *Barringtonia acutangula* sparse shrubland in the midstorey and an *Eriachne triseta* sparse grassland understorey	U+ ^*Melaleuca viridiflora*, *Eucalyptus alba*, *Acacia lacertensis*\tree\7\i	M Dead *Acacia*, *Pandanus spiralis*, *Barringtonia acutangula*\palm, ^shrub\4\r	*Eriachne triseta*, Grass sp.\^grass\2\r
71_2A	30	274867	8598333	Mixed Riparian - Braided Channel	Mixed *Acacia mimula*, *Acacia dimidiata*, *Acacia latescens* woodland with a *Jacksonia dilatata* sparse shrubland in the midstorey and an annual *Sorghum* sp. open grassland understorey	U+ *Acacia mimula*, *Acacia dimidiata*, *Acacia latescens*\shrub, trees\7\i	M *Jacksonia dilatata*, *Petalostigma pubescens*, *Calytrix achaeta*\shrub\4\r	^*Sorghum* sp., *Eriachne triseta* \grass\2\i
71_2B	30	274485	8598498	Mixed Riparian - Braided Channel	*Melaleuca viridiflora* closed shrubland with a *Germainia truncatiglumis* grassland understorey		M+ *Melaleuca viridiflora*\shrub\4\d	^*Germainia truncatiglumis*, *Pandanus spiralis*\^grass, palm\2\c
71_3?	30	274463	8598466	Mixed Riparian - Braided Channel	*Melaleuca viridiflora*, *Eucalyptus alba* open woodland with a *Germainia truncatiglumis* closed grassland understorey	U+ *Melaleuca viridiflora*, *Eucalyptus alba*\tree\7\r		^*Germainia truncatiglumis*, *Melaleuca viridiflora*, *Pandanus spiralis*\^grass, shrub, palm\2\d

Survey Site ID	Vegetation Mapping Group ID	Easting	Northing	Vegetation Mapping Group	Vegetation Descriptions	NVIS 5 Upperstorey	NVIS 5 Midstorey	NVIS 5 Groundstorey
72_1	12	275003	8597442	*Eucalyptus tetrodonta* open woodland	*Eucalyptus tetrodonta* open woodland with a *Xanthostemon paradoxus* sparse shrubland in the midstorey and an *Eriachne triseta* sparse grassland understorey	U ^*Eucalyptus tetrodonta*, *Eucalyptus miniata*, *Xanthostemon paradoxus*\^tree\6\r	M+ ^*Xanthostemon paradoxus*, *Acacia holosericea*, *Eucalyptus tetrodonta*\shrub\4\r	^*Eriachne triseta*\grass\3\r
82_1	3	274908	8597563	*Acacia holosericea* shrubland	Isolated *Eucalyptus* sp. trees with a dominant *Acacia holosericea* shrubland in the midstorey and an *Eriachne triseta* open grassland understorey	U ^Dead *Eucalyptus*, *Corymbia porrecta*\tree\7\bi	M+ ^*Acacia holosericea*, *Eucalyptus tetrodonta*, dead *Acacia* sp.\shrub\4\c	^*Eriachne triseta*, Passiflora foetida\^grass, vine\2\i
9 new	10	275809	8597174	*Eucalyptus* open woodland	*Eucalyptus miniata*, *Terminalia erythrocarpa*, *Eucalyptus tetrodonta* open woodland with a *Eucalyptus* sp. sparse shrubland in the midstorey and an annual *Sorghum* sp. sparse grassland understorey	U+ *Eucalyptus miniata*, *Terminalia erythrocarpa*, *Eucalyptus tetrodonta*\^tree\7\r	M ^*Eucalyptus* sp., Dead shrubs, *Pandanus spiralis*\^shrub\4\r	*Sorghum* sp.\grass\2\r
9_1	11	274728	8597815	*Eucalyptus* shrubland	Isolated dead *Eucalyptus* sp. trees with *Eucalyptus tetrodonta* shrubland in the midstorey	U ^Dead *Eucalyptus* sp.\tree\7\bi	M+ ^*Eucalyptus tetrodonta*, dead *Acacia* sp.\^shrub\4\c	G+ ^*Eriachne triseta*, *Ectrosia leporina*\grass\2\d
91_1	26	275891	8597761	*Melaleuca viridiflora* open forest	*Melaleuca viridiflora* open forest with isolated *Pandanus spiralis* palms in the midstorey and Grass sp. Grassland understorey	U+ *Melaleuca viridiflora*\tree\7\c	M *Pandanus spiralis*\palm\4\bi	Grass sp., *Mnesithia rottboellioides*\grass\2\c
91_2	26	275899	8597716	*Melaleuca viridiflora* open forest	*Melaleuca viridiflora* open forest	U+ *Melaleuca viridiflora*\tree\6\c		
91_4	26	275891	8597692	*Melaleuca viridiflora* open forest	*Eucalyptus alba* open woodland with a *Mnesithia rottboellioides* grassland understorey	U+ ^*Eucalyptus alba*, *Corymbia polycarpa*, *Lophostemon grandiflorus*\tree7\r		*Mnesithia rottboellioides*\grass\2\c
99_1	26	275415	8596845	*Melaleuca viridiflora* open forest	*Melaleuca viridiflora* open forest with a Grass sp. open grassland understorey	U^ *Melaleuca viridiflora*\trees\6\c		^Grass sp.\grass\2\i

APPENDIX E: VEGETATION SURVEY PHOTOS

Site 1-1, vegetation mapping group 30 mixed riparian

Site 2-1, vegetation mapping group 13 *Eucalyptus tetrodonta* woodland

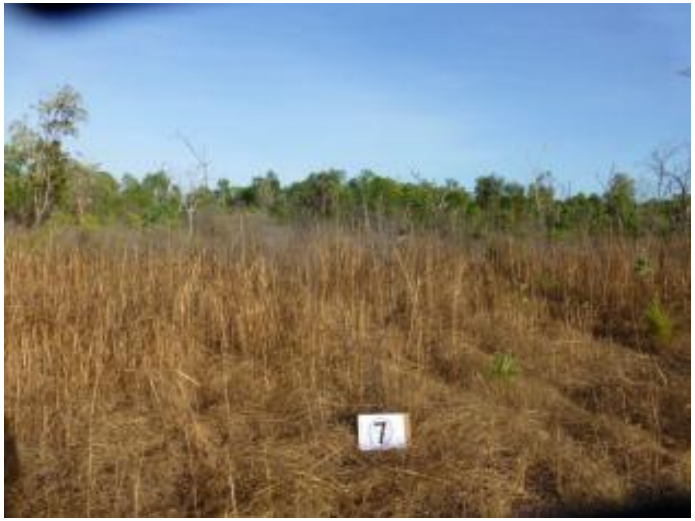
Site 3, vegetation mapping group 23 *Sorghum* grassland

Site 5, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 6-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

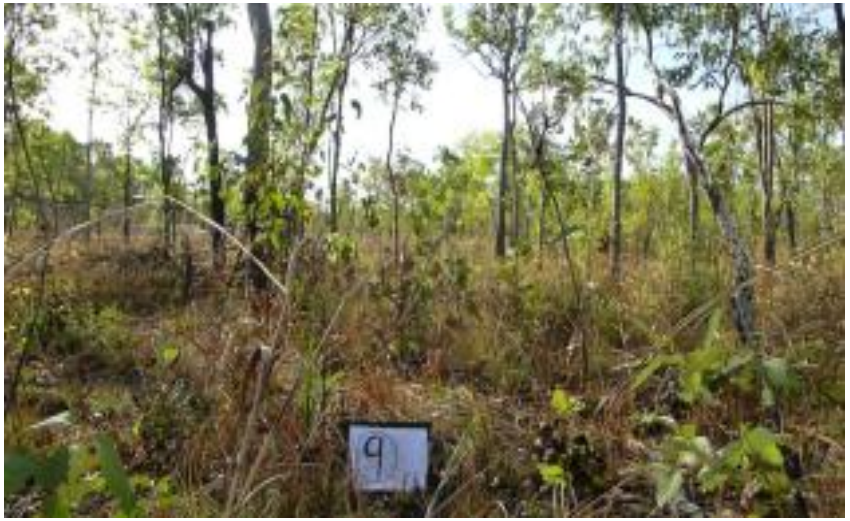
Site 6, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 6, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

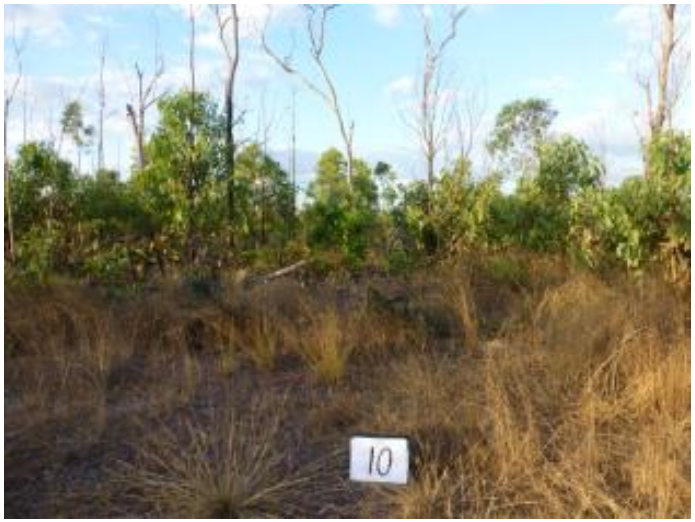


Site 7, vegetation mapping group 33 *Calytrix* open shrubland

Site 9, vegetation mapping group 10 *Eucalyptus* open woodland



Site 9 new, vegetation mapping group 10 *Eucalyptus* open woodland



Site 10, vegetation mapping group 11 *Eucalyptus* shrubland

Site 10, vegetation mapping group 11 *Eucalyptus* shrubland, including regrowth in cleared line (center)

Site 103, vegetation mapping group 8 *Corymbia* open woodland

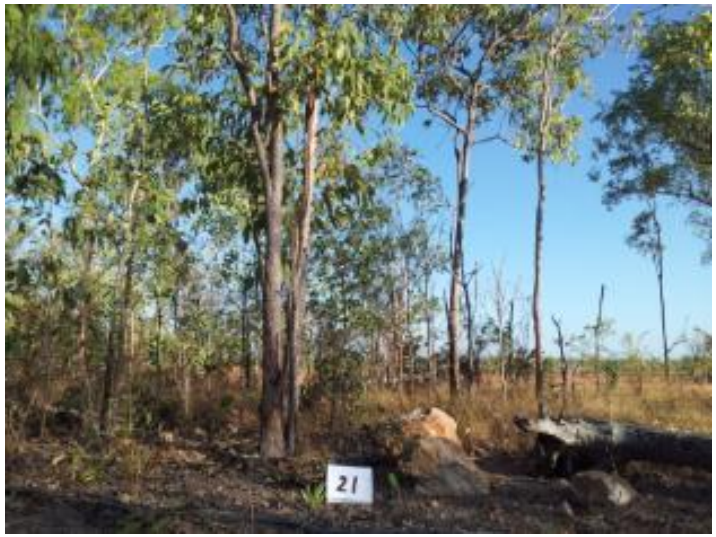
Site 14-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 17, vegetation mapping group 3 *Acacia holosericea* shrubland

Site 18, vegetatipn mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 19, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 20-1, vegetation mapping group 2 *Acacia holosericea* open shrubland



Site 21-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 22-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 31-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

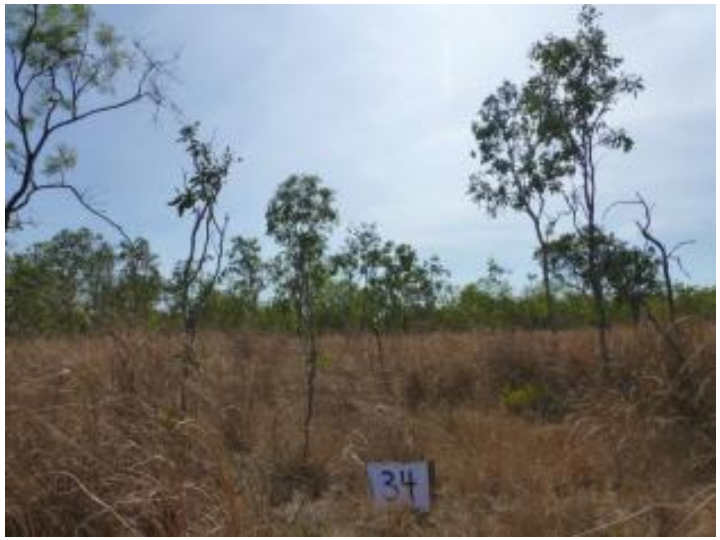
Site 31-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 31-1E, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 31-2E, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 31-5, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 34, vegetation mapping group 27 *Melaleuca viridiflora* open woodland

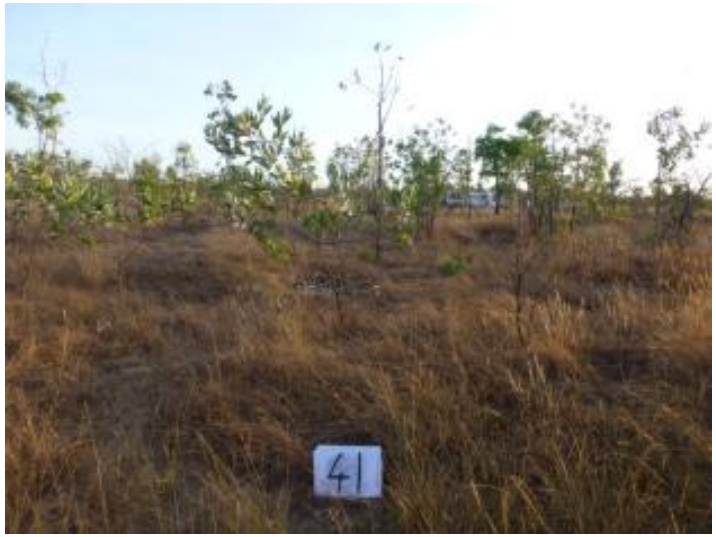


Site 34, vegetation mapping group 27 *Melaleuca viridiflora* open woodland

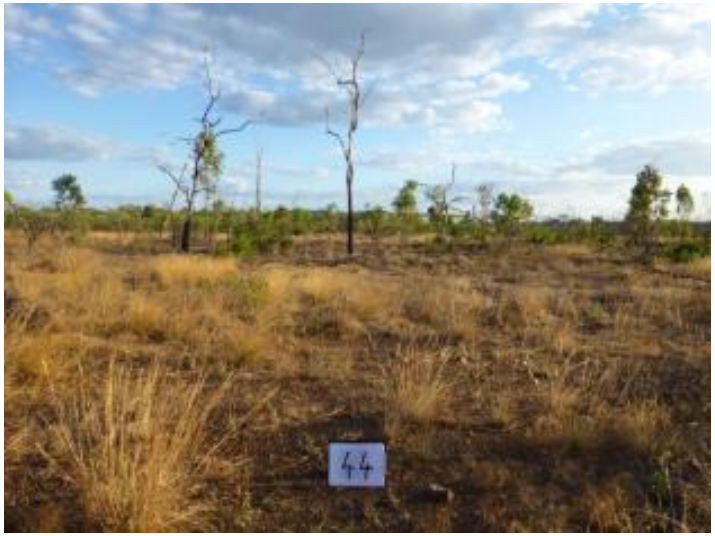
Site 37, vegetation mapping group 32 Georgetown Billabong fringe

Site 38, vegetation mapping ggroup 12 *Eucalyptus tetrodonta* open woodland

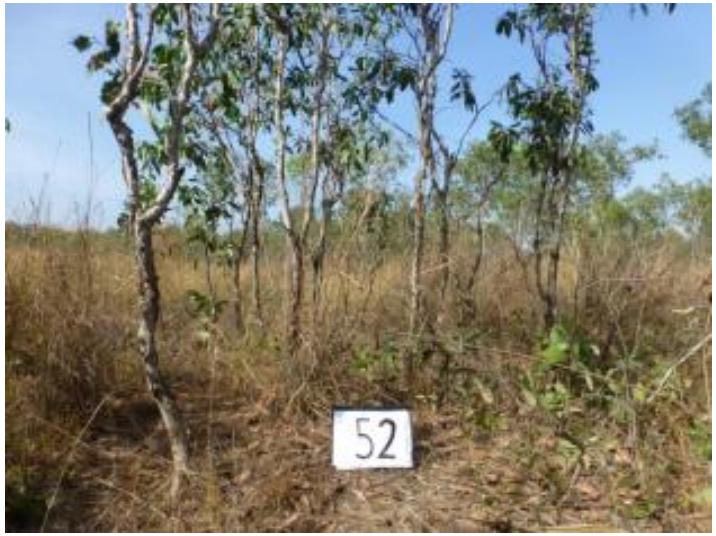
Site 40-1, vegetation mapping ggroup 13 *Eucalyptus tetrodonta* woodland



Site 41, vegetation mapping group 17 *Eriachne triseta* grassland

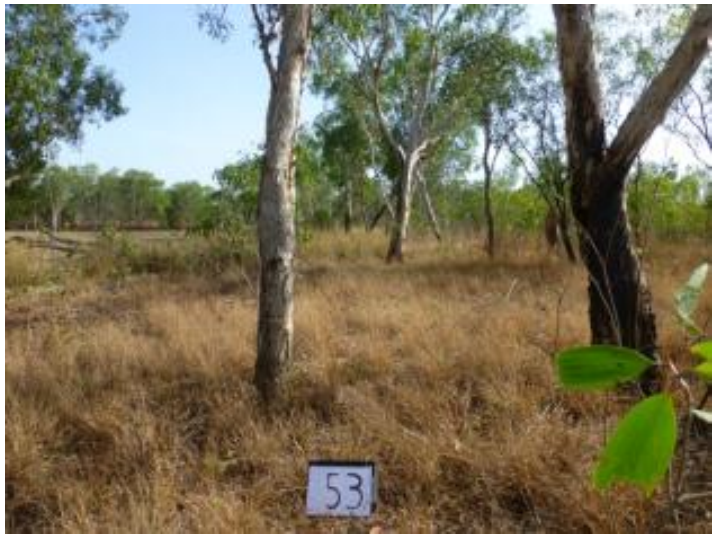


Site 44, vegetation mapping group 17 *Eriachne triseta* grassland



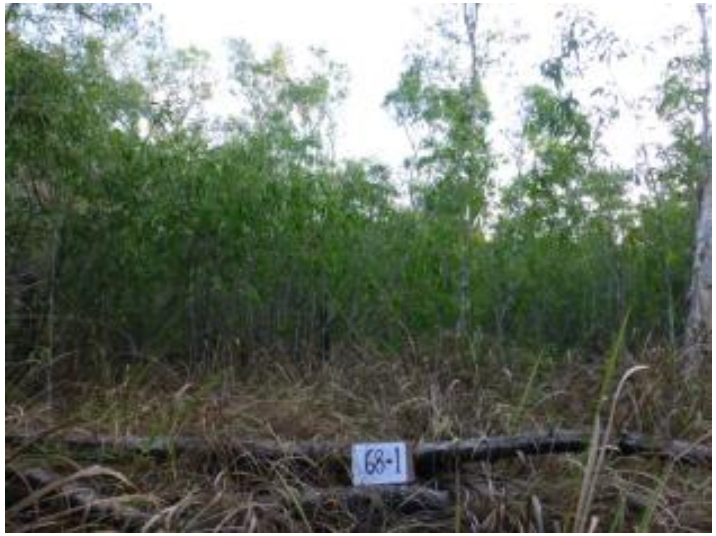
Site 52, vegetation mapping group 28 *Melaleuca viridiflora* shrubland

Site 52, vegetation mapping group 28 *Melaleuca viridiflora* shrubland



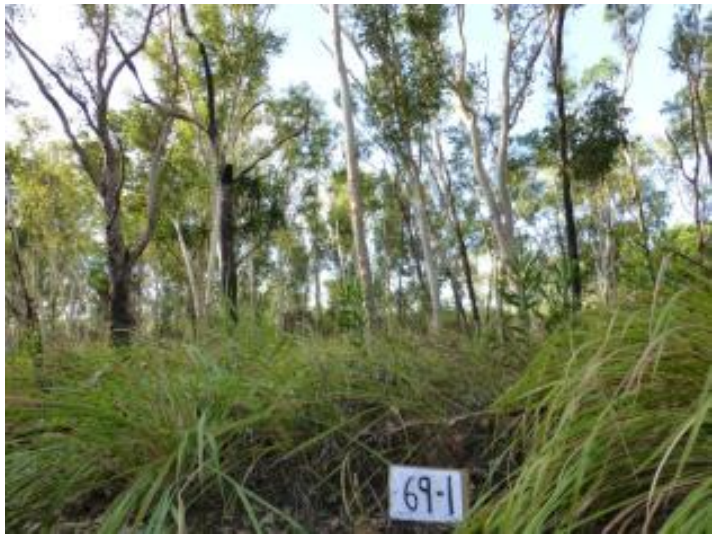
Site 53, vegetation mapping group 26 *Melaleuca viridiflora* open forest

Site 64, vegetation mapping group 17 *Eriachne triseta* grassland



Site 68-1, vegetation mapping group 30 mixed riparian

Site 68-3, vegetation mapping group 30 mixed riparian

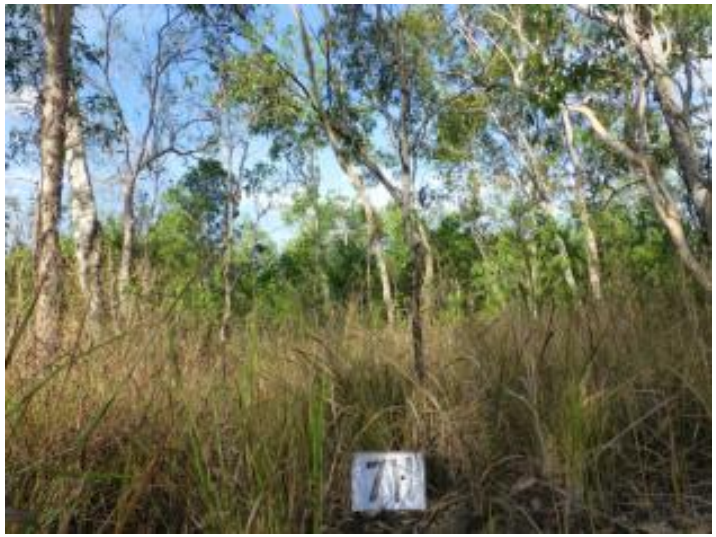


Site 69-1, vegetation mapping group 30 mixed riparian

Site 71, vegetation mapping group 30 mixed riparian

Site 71-1A, vegetation mapping group 30 mixed riparian

Site 71-1A, vegetation mapping group 30 mixed riparian



Site 71-1B, vegetation mapping group 30 mixed riparian

Site 71-1C, vegetation mapping group 30 mixed riparian

Site 71-2A, vegetation mapping group 30 mixed riparian

Site 71-2, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 75, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 79, vegetation mapping group 7 Dead *Acacia* open shrubland

Site 82, vegetation mapping group 3 *Acacia holosericea* shrubland

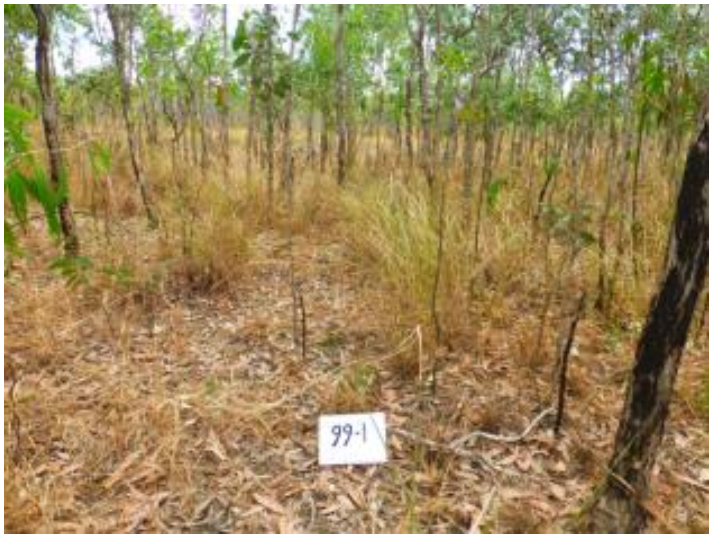
Site 91-1, vegetation mapping group 26 *Melaleuca viridiflora* open forest

Site 91-2, vegetation mapping group 26 *Melaleuca viridiflora* open forest

Site 91-4, vegetation mapping group 26 *Melaleuca viridiflora* open forest

Site 95, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 98, vegetation mapping group 30 mixed riparian



Site 99-1, vegetation mapping group 26 *Melaleuca viridiflora* open forest

Site 100-1, vegetation mapping group 8 *Corymbia* open woodland

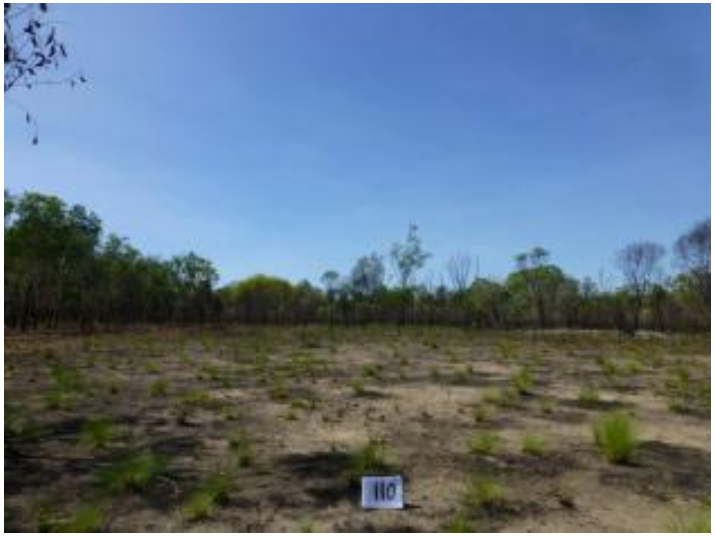
Site 101-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 101-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 102-1, vegetation mapping group 12 *Eucalyptus tetrodonta* open woodland

Site 105-1, vegetation mapping group 8 *Corymbia* open woodland

Site 106-1, vegetation mapping group 18 *Eriachne triseta* open grassland



Site 110, vegetation mapping group 19 grassland

Site 122, vegetation mapping group 22 *Pseudoraphis spinescens* closed grassland

Site 123, vegetation mapping group 30 mixed riparian

Site 127, vegetation mapping group 30 mixed riparian

Site 127, vegetation mapping group 30 mixed riparian

Site 128, vegetation mapping group 20 *Heteropogon triticeus* open grassland

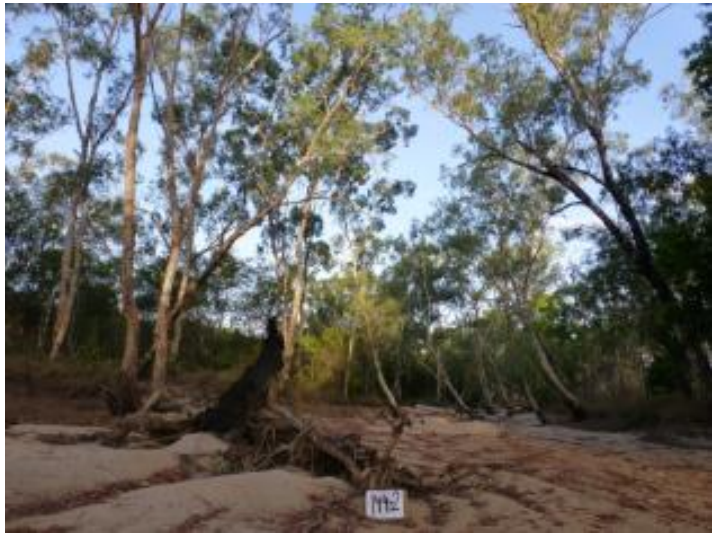
Site 129, vegetation mapping group 21 *Heteropogon triticeus* sparse grassland

Site 130, vegetation mapping group 21 *Heteropogon triticeus* sparse grassland

Site 134_1, vegetation mapping group 23 *Sorghum* grassland

Site 144, vegetation mapping group 25 *Melaleuca argentea* open woodland/woodland

Site 144-1, vegetation mapping group 25 *Melaleuca argentea* open woodland/woodland



Site 144-2, vegetation mapping group 25 *Melaleuca argentea* open woodland/woodland

Site 148F, vegetation mapping group 29 *Melaleuca viridiflora* woodland

Site 148F, vegetation mapping group 29 *Melaleuca viridiflora* woodland

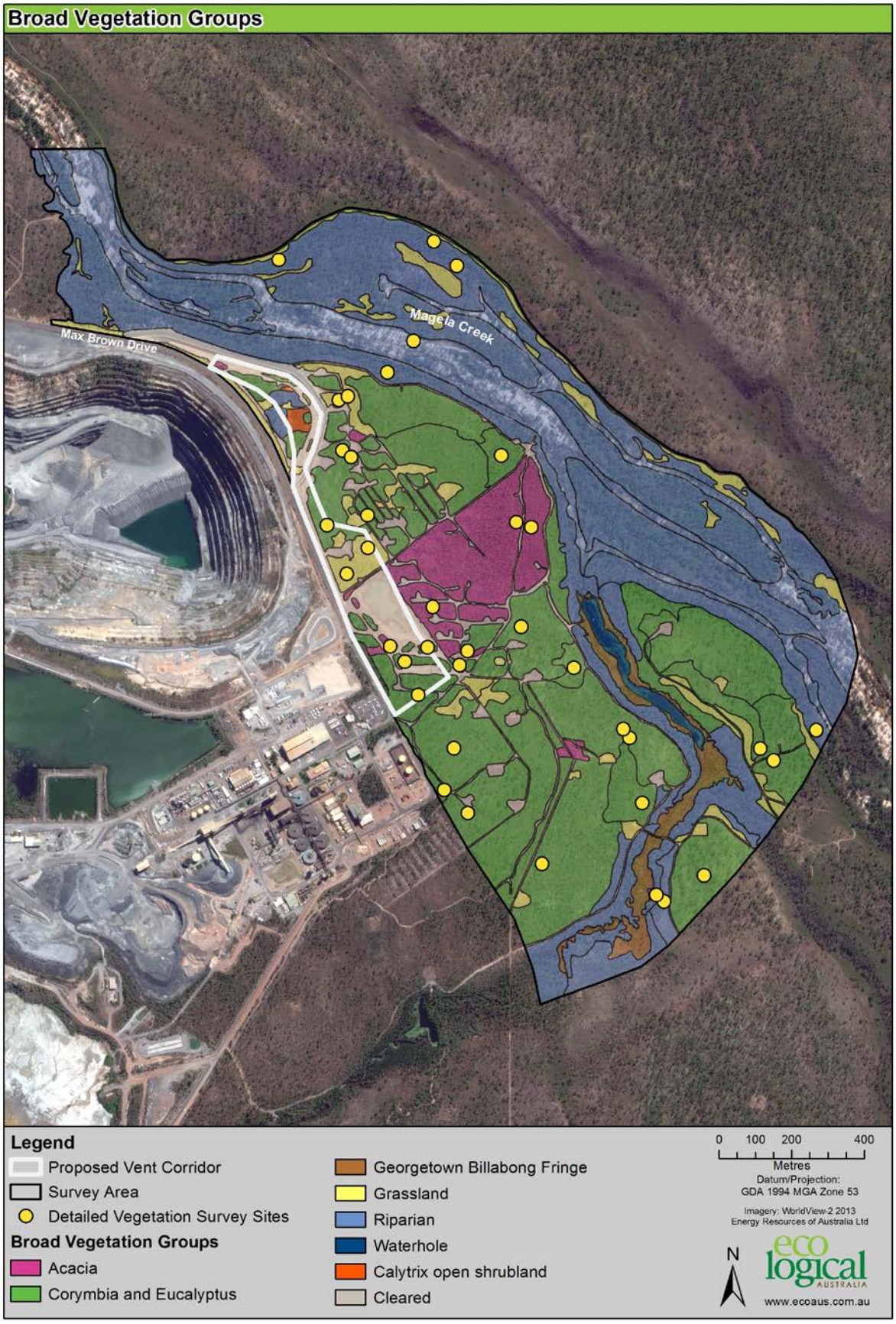
Site 148-2F, vegetation mapping group 29 *Melaleuca viridiflora* woodland

Site 149-1B, vegetation mapping group 13 *Eucalyptus tetrodonta* woodland

Site 157, vegetation mapping group 11 *Eucalyptus* shrubland

Site 39_2 vegetation mapping group 5 Acacia open shrubland

APPENDIX F: DETAILED VEGETATION COMMUNITY SURVEYS SITE DESCRIPTION



Detailed vegetation survey sites

Site	Date	Survey	Observers	Comments	MGA Zone	Easting	Northing	Site Disturbance %	Disturbance Frequency	Nearest Water	Site Drainage	Climate	Grazing	Grazing Type	Fire Frequency (years)	Fire Intensity
3	8/09/2013	ERA EIS	SD, AZ	Small patch with a lot of disturbance surrounding (tracks and drilling activities)	53	274650	8598132	Extensive clearing surrounding unit	Few recent 1-10 yrs	Ephemeral creek	1	2			1-2	Minor impact scars on most trees / shrubs
6	9/09/2013	ERA EIS	SD, AZ	Very disturbed, area may have been historically cleared. Also large fire may have passed through a few years ago	53	274617	8597788	Extensive clearing, exotic weeds	Few recent 1-10 yrs	Ephemeral creek	1				2-5	Some trees / shrubs killed
23	8/09/2013	ERA EIS	AZ	Large patch with dominant Acacia shrub layer and scattered tall Eucalypts which have died out in places (possibly due to irrigation) thick leaf layer=long unburnt	53	275138	8597796	Exotic weeds		Ephemeral creek	1	2			>5	some trees / shrubs killed
27	8/09/2013	ERA EIS	AZ	Similar to 23, unburnt >5yrs, Mainly *Acacia* shrubland, patches with regrowth	53	275178	8597782	None		Ephemeral creek			Nil		>5	Minor impact scars on some trees / shrubs
38	10/09/2013	ERA EIS	SD, AZ	Many trees uprooted, possibly due to cyclone. Also fairly hot fire has been through in past, fire scars deep on trees, also fires must be quite recurrent as regeneration hasn't had much chance to establish	53	275654	8596825		Few recent 1-10 yrs	Ephemeral creek	1	2			1-2	Minor impact scars on most trees / shrubs, some trees / shrubs killed
41	9/09/2013	ERA EIS	SD, AZ	Same as 44 but more advanced regrowth, also no *Flagellaria*. Has also been partially cleared for drilling, highly disturbed area	53	274671	8597654	Extensive clearing, exotic weeds	Many <10yrs	Ephemeral creek	1	2			2-5	Some trees / shrubs killed
44	8/09/2013	ERA EIS	SD, AZ	Heavily disturbed, standing tall trees are dead appears to have been ripped or cleared in past, sparse regrowth, mainly mixed grassland	53	274729	8597725	Extensive clearing, exotic weeds	Many <10yrs	Ephemeral creek	1	2			1-2	Minor impact scars on most trees / shrubs
52	10/09/2013	ERA EIS	SD, AZ		53	275543	8596753	Limited clearing		Ephemeral creek	2	2			Nil	No damage
53	10/09/2013	ERA EIS	SD, AZ		53	275522	8596771	Pig rooting	Few recent 1-10 yrs	Ephemeral creek	2	2			Nil	No damage
84	8/09/2013	ERA EIS	SD, AZ	Unit is bound by tracks and cleared areas, a lot of regeneration, maybe severe fire in past, several burnt logs on ground and some stags, cleared at edges too	53	274660	8597994	Extensive clearing	Few recent 1-10 yrs	Ephemeral creek	1	2			1-2	Minor impact scars on most trees / shrubs
95	9/09/2013	ERA EIS	SD, AZ, ID	Burnt woodland with mixture of species	53	275809	8597174	Pig rooting	Few recent 1-10 yrs	Ephemeral creek	1	2			1-2	Minor impact, scars on most trees / shrubs
103	10/09/2013	ERA EIS	SD, AZ	Near two clearings, fairly diverse but a lot of dead *Acacias*, in a slight depression so there are more damp loving spp. e.g. *Pandanus*	53	275449	8597202	Exotic weeds and pig rooting	Few recent 1-10 yrs	Ephemeral creek	2	2		Pigs	2-5	Minor impact scars on most trees / shrubs, some trees / shrubs killed
135	9/09/2013	ERA EIS	SD, AZ, ID	A lot of dead regen / seedlings from fire	53	275845	8597141	Pig rooting	Few recent 1-10 yrs	Ephemeral creek	1	2		Pigs	1-2	Minor impact scars on most trees / shrubs, some trees / shrubs killed

Site	Date	Survey	Observers	Comments	MGA Zone	Easting	Northing	Site Disturbance %	Disturbance Frequency	Nearest Water	Site Drainage	Climate	Grazing	Grazing Type	Fire Frequency (years)	Fire Intensity
1-1	9/09/2013	ERA EIS	SD, AZ	Higher areas have *Acacias* and *Eriachne* grasses and *Eucalyptus alba*. Low lying area have mid-open *Melaleuca* forests with open forests next to grassland	53	274783	8598208	exotic weeds (wild passionfruit)		Swamp, ephemeral creek	2	2			Nil	No damage
6-1	5/09/2013	ERA EIS	AZ	Transect A	53	274683	8597975	Limited clearing, exotic weeds	Few recent 1-10 yrs	Ephemeral creek	1	1	Nil		2-5	Most trees / shrubs killed
20-1	8/09/2013	ERA EIS	SD, AZ	Small narrow remnant surrounded by clearing, tracks, drill pads, several dead trees / stags possibly from too much irrigation. Very few live trees left in upper stratum. On hill crest / upper slope. Similar to 22-1 but fewer trees	53	274791	8597455	Extensive clearing nearby, Exotic weeds (passionfruit)		Ephemeral creek	1	2			2-5	Minor impact scars on most trees / shrubs
21-1	8/09/2013	ERA EIS	SD, AZ	Small strip between dam and track, patch in middle has been cleared	53	274893	8597452	Extensive clearing, Exotic weeds (passionfruit)		Ephemeral creek	1	2			2-5	Minor impact scars on most trees / shrubs
22-1	8/09/2013	ERA EIS	SD, AZ	Small remnant between drill lines / tracks that are cleared. Several dead stags, cause of death unknown, maybe from irrigation. Crest of hill	53	274831	8597412	Extensive clearing nearby, Exotic weeds (passionfruit)	Many <10yrs	Ephemeral creek	1	2			2-5	Minor impact scars on most trees / shrubs
26-1	7/09/2013	ERA EIS	SD, AZ, CG	Similar to 40-1 but mid storey has dropped out and fewer trees in upper. Irrigated area (Magela B). Some trees cut down. On crest of hill	53	274966	8597175	Pig rooting			1	2			1-2	Minor impact scars on most trees / shrubs
29-1	7/09/2013	ERA EIS	SD, AZ, CG	Top of hill. Some trees have been cut down probably because of irrigation line. A lot of stags	53	275004	8596996	Clearing nearby				2			2-5	Some trees / shrubs killed
31-1	6/09/2013	ERA EIS	AZ	Last burn 2012, big fire in past, many logs	53	275208	8596856	None		Ephemeral creek		1	Nil		1-2	some trees / shrubs killed
100-1	7/09/2013	ERA EIS	AZ, SD, CG		53	275296	8597395	None		Ephemeral creek					1-2	Minor impact scars on most trees / shrubs
101-1	8/09/2013	ERA EIS	SD, AZ, DM	Large patch, some disturbance within. Adjacent to tracks, some dead trees / stags	53	275151	8597509	Limited clearing	Few recent 1-10 yrs	Ephemeral creek	1	2			2-5	Minor impact scars on most trees / shrubs
102-1	7/09/2013	ERA EIS	SD, AZ, CG	Recent, possibly hot fire, many shrubs killed	53	275432	8597227	Clearing nearby	Few recent 1-10 yrs	Ephemeral creek	1	2			<1	Some trees / shrubs killed
105-1	7/09/2013	ERA EIS	SD, AZ, CG	Maybe severe fire in past some dead shrubs but trees look healthy	53	275484	8597023	Pig rooting		Ephemeral creek	2	2			2-5	Minor impact scars on most trees / shrubs
134-1	8/09/2013	ERA EIS	AZ	Disturbed (fire)	53	274674	8598143	None				1			1-2	Minor impact scars on most trees / shrubs
144-1A	9/09/2013	ERA EIS	SD, AZ	Magela creek bed	53	274854	8598295			Ephemeral creek	2	2			Nil	No damage
148-1	6/09/2013	ERA EIS	AZ		53	275963	8597224	Flood	Current	Ephemeral creek					1-2	Minor impact scars on most trees / shrubs

Site	Date	Survey	Observers	Comments	MGA Zone	Easting	Northing	Site Disturbance %	Disturbance Frequency	Nearest Water	Site Drainage	Climate	Grazing	Grazing Type	Fire Frequency (years)	Fire Intensity
149-1	5/09/2013	ERA EIS	AZ	Fauna transect B, unburnt in 2013, severe fire in past scars up to 10 m high. Sloping, irrigated in past		275096	8597980	None		Ephemeral creek			Nil		2-5	some trees / shrubs killed
39-1	6/09/2013	ERA EIS	AZ	Fauna transect D, opposite gatehouse carpark, next to small cleared area with some regrowth	53	274867	8597321	Limited clearing		Ephemeral creek		1	Nil		>5	Minor impact scars on some trees / shrubs
40-1	7/09/2013	ERA EIS	SD, AZ, CG	Doesn't get burnt as regularly as adjacent to diesel tanks. Has had a big fire about 4-5 yrs ago. Area not irrigated	53	274939	8597059			Ephemeral creek	1	2			2-5	Minor impact scars on most trees / shrubs
4 new	8/09/2013	ERA EIS	SD, AZ	Small narrow remnant between several tracks. Some dead trees probably from irrigation	53	274982	8597403	Extensive clearing, exotic weeds	Few recent 1-10 yrs	Ephemeral creek	1	2	Nil		2-5	Minor impact scars on most trees / shrubs
71-1B	9/09/2013	ERA EIS	SD, AZ	Riparian zone of Magela Ck. Water likely to have been pooling here therefore no grass. Next to it there are grasses and *Melaleuca viridiflora* regeneration in same veg type.	53	274911	8598568	Pig rooting	Single recent	Ephemeral creek	2	2			2-5	Minor impact, scars on most trees / shrubs
71-1C	5/09/2013	ERA EIS	AZ	Fauna transect C	53	274974	8598502	Flood	Current	Ephemeral creek			Nil		<1	Minor impact scars on most trees / shrubs
71-2A	9/09/2013	ERA EIS	SD, AZ	Elevated sand dune on bank of Magela creek	53	274485	8598518	Pig rooting	Few recent 1-10 yrs	Ephemeral creek		2			>5	No damage
72-1	8/09/2013	ERA EIS	AZ, DM	All large trees dead, old logs, clearing nearby, Eucalypts reaching canopy height	53	275003	8597442	None		Ephemeral creek	1	1	Nil		>5	No damage
82-1	8/09/2013	ERA EIS	AZ, SD	Old irrigation, all us trees dead, unburnt, last fire >2yrs, *Acacia* senescing, litter build up	53	274908	8597563									
9_1	8/09/2013	ERA EIS	AZ	Upper storey dead. Past disturbance created very patchy vegetation community: Eucalyptus shrublands interspersed with Eriachne grasslands	53	274728	8597815	50% clearing		Ephemeral creek			Nil		2-5	some trees / shrubs killed

APPENDIX G: SURVEY SITE DATA

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
3	*Corymbia bleeseri*	N			14	3					
3	*Xanthostemon paradoxus*	N			10	1					
3	*Eucalyptus tetrodonta*	N			12	1					
3	*Calytrix exstipulata*	N			2			10			
3	*Eucalyptus* spp. (juvenile)	N			5			5			
3	*Sorghum* sp. (sterile)	N			1					40	
3	*Eriachne triseta*	N			0.7					20	
6	*Corymbia bleeseri*	N				3					
6	*Eucalyptus tetrodonta*	N				3					
6	*Xanthostemon paradoxus*	N				1		5			
6	Dead tree sp.	N				1					
6	*Acacia holosericea*	N						5			
6	*Planchonia careya*	N						5			
6	Dead *Acacias*	N						1			
6	*Eriachne triseta*	N									30
6	*Grass* sp. (sterile)	N									10
23	*Eucalyptus tetrodonta*	N				3					
23	Dead tree sp.	N				1					
23	*Acacia holosericea*	N						20			
23	*Calytrix exstipulata*	N						5			
23	*Eucalyptus* spp. (juvenile)	N						3			
23	*Xanthostemon paradoxus*	N						1			
23	*Alstonia actinophylla*	N						1			
23	*Buchanania obovata*	N						1			
23	*Heteropogon triticeus*	N								5	
23	*Eriachne triseta*	N								3	
23	*Petalostigma pubescens*	N								3	
23	*Passiflora foetida*	N								1	
27	Dead *Eucalyptus* sp.	N			14	25					
27	*Acacia oncinocarpa*	N			6			20			
27	*Acacia holosericea*	N			6			10			
27	*Eucalyptus tetrodonta*	N			6			10			
27	*Eucalyptus miniata*	N			6			10			
27	*Xanthostemon paradoxus*	N			6			10			
27	*Petalostigma quadrioculare*	N			0.6					3	
27	*Calytrix exstipulata*	N			0.7					3	
27	*Sorghum* sp. (sterile)	N			1					1	
27	*Eriachne triseta*	N			0.5					1	
38	*Eucalyptus tetrodonta*	N				5					
38	*Planchonia careya*	N				3		1			
38	*Erythrophleum chlorostachys*	N				3		1			
38	*Eucalyptus miniata*	N				3					

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
38	*Xanthostemon paradoxus*	N				3					
38	Dead tree sp.	N				1					
38	*Syzygium suborbiculare*	N				1					
38	*Alstonia actinophylla*	N				1					
38	*Syzygium* sp.	N				1					
38	*Pandanus spiralis*	N						1			
38	*Petalostigma pubescens*	N						1			
38	*Sorghum* sp. (sterile)	N								5	
38	*Eriachne triseta*	N								5	
38	*Hibbertia juncea*	Y								3	
38	*Eucalyptus* spp. (juvenile)	N								3	
38	*Spermacoce* sp.	N								1	
38	*Acacia difficilus*	N								1	
38	*Hibbertia* sp.	N								1	
38	*Ficus* sp. (Sandpaper Fig)	N								1	
38	*Grevillea* sp.	N								1	
38	*Buchanania obovata*	N								1	
41	*Corymbia bleeseri*	N			6	3					
41	*Eucalyptus tetrodonta*	N			7	1					
41	*Planchonia careya*	N			4	1					
41	*Acacia holosericea*	N			2			8			
41	*Eucalyptus* spp. (juvenile)	N			2			3			
41	*Eriachne triseta*	N			1					40	
41	*Grass* sp. (sterile)	N			1					20	
44	*Corymbia bleeseri*	N			4	3					
44	*Eucalyptus tetrodonta*	N			4	1					
44	*Acacia holosericea*	N			2			5			
44	*Flagellaria indica*	N						1			
44	*Eriachne triseta*	N			1					40	
44	*Grass* sp.	N			1					20	
44	*Waltheria* sp.	N								1	
52	*Melaleuca viridiflora*	N						30			
52	*Melaleuca dealbata*	N						20			
52	Asteromyrtus symphyocarpa	Y						10			
52	*Germainia truncatiglumis*	Y								30	
52	*Sorghum ?plumosum*	N								20	
52	*Eriachne triseta*	N								20	
53	*Melaleuca viridiflora*	N				70					
53	*Germainia truncatiglumis*	Y								30	
53	*Poaceae indent*	Y								20	
84	*Eucalyptus tetrodonta*	N			12	5					
84	*Xanthostemon paradoxus*	N			8	1		5			

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
84	*Eucalyptus* spp. (juvenile)	N			5			5			
84	*Planchonia careya*	N			4			1			
84	*Eriachne triseta*	N			0.8					15	
84	*Sorghum* sp. (sterile)	N			1.2					5	
95	*Eucalyptus miniata*	N			13	5					
95	*Terminalia erythrocarpa*	N			12	5					
95	*Eucalyptus tetrodonta*	N			12	3					
95	*Syzygium suborbiculare*	N			10	1					
95	*Eucalyptus* spp. (juvenile)	N			5			5			
95	Dead regeneration/seedlings	N			6			5			
95	*Pandanus spiralis*	N			4			3			
95	*Erythrophleum chlorostachys*	N			5			3			
95	*Livistona humilis*	N			5			1			
95	*Sorghum* sp.	N			0.5					5	
103	*Corymbia foelscheana*	N				5		3			
103	*Wrightia saligna*	N				3					
103	*Eucalyptus* sp.	N				1					
103	Dead *Acacias*	N						5			
103	*Pandanus spiralis*	N						3		5	
103	*Wrightia saligna*	N						3		1	
103	*Buchanania obovata*	N						3			
103	*Planchonia careya*	N						3			
103	*Cochlospermum fraseri*	N						3			
103	*Petalostigma pubescens*	N						3			
103	*Eriachne triseta*	N								11	
103	*Sorghum* sp. (sterile)	N								10	
103	*Heteropogon triticeus*	N								3	
103	*Passiflora foetida*	N								1	
103	*Panicum* sp.	N								1	
135	*Eucalyptus tetrodonta*	N				25					
135	*Erythrophleum chlorostachys*	N				10		1			
135	*Eucalyptus miniata*	N				5					
135	*Persoonia falcata*	N						5			
135	*Pandanus spiralis*	N						5			
135	*Planchonia careya*	N						5			
135	*Buchanania obovata*	N						1			
135	*Terminalia erythrocarpa*	N						1			
135	*Sorghum* sp. (sterile)	N								10	
1-1	*Melaleuca viridiflora*	N				30					
1-1	*Eucalyptus alba var. australasica*	N				1					
1-1	*Acacia lacertensis*	Y						5			
1-1	*Pandanus spiralis*	N						3			

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
1-1	*Acacia holosericea*	N						3			
1-1	*Syzygium forte*	N						3			
1-1	*Melaleuca leucadendra*	N						1			
1-1	*Mnesithea rottboellioides*	N								5	
1-1	*Leptocarpus spathaceus*	Y								5	
1-1	*Passiflora foetida*	N								3	
1-1	*Eriachne triseta*	N								3	
1-1	*Syzygium armstrongii*	N								1	
1-1	*Eragrostis* sp.	N								1	
1-1	*Hibiscus* sp.	N								1	
6-1	*Corymbia bleeseri*	N				5		5			
6-1	Dead *Eucalyptus* sp.	N				5					
6-1	*Eucalyptus tetrodonta*	N				5					
6-1	*Eucalyptus miniata*	N				1					
6-1	*Eucalyptus* regrowth *(?E. tetrodonta)*	N	3	4	3.5		5	15		10	
6-1	*Xanthostemon paradoxus*	N						5		10	
6-1	Dead *Acacia* sp.	N						1			
6-1	*Planchonia careya*	N						1			
6-1	*Pseudopogonatherum* sp.	Y								5	
6-1	*Passiflora foetida*	N								5	
6-1	*Heteropogon triticeus*	N								5	
6-1	*Eriachne triseta*	Y								5	
6-1	*Acacia* sp. (juvenile)	N								1	
6-1	*Cenchrus polystachios*	N								1	
6-1	*Setaria* sp.	N								1	
20-1	*Eucalyptus tetrodonta*	N	10	14	12	3					
20-1	*Acacia holosericea*	N	4	5	4			20			
20-1	*Heteropogon triticeus*	N			1			15			
20-1	*Calytrix exstipulata*	N			2			5			
20-1	*Xanthostemon paradoxus*	N	4	5	5			5			
20-1	*Eriachne triseta*	N			0.7			5			
21-1	*Eucalyptus tetrodonta*	N			12	10					
21-1	*Eucalyptus miniata*	N			12	5					
21-1	*Corymbia porrecta*	N			10	5					
21-1	*Corymbia bleeseri*	N			15	1					
21-1	*Alstonia actinophylla*	N			12	1					
21-1	*Acacia holosericea*	N			6			10			
21-1	*Xanthostemon paradoxus*	N			8			5			
21-1	*Eriachne triseta*	N			1					10	
21-1	*Buchanania obovata*	N			2					5	
21-1	*Heteropogon triticeus*	N			5					5	
21-1	*Calytrix exstipulata*	N			3					3	

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
22-1	*Eucalyptus tetrodonta*	N	12	14	13	5					
22-1	*Acacia holosericea*	N	4	5	5			20			
22-1	*Calytrix exstipulata*	N			2			10			
22-1	*Xanthostemon paradoxus*	N	4	5	5			10			
22-1	*Heteropogon triticeus*	N			1					15	
22-1	*Eriachne triseta*	N			0.7					5	
22-1	*Waltheria* sp.	N			0.3					1	
26-1	*Eucalyptus tetrodonta*	N				5					
26-1	Dead tree sp.	N				3					
26-1	*Eucalyptus miniata*	N				3					
26-1	*Eucalyptus* spp. (juvenile)	N						10		10	
26-1	*Alstonia actinophylla*	N						1			
26-1	*Heteropogon triticeus*	N								25	
29-1	*Eucalyptus tetrodonta*	N			12.5	10					
29-1	*Corymbia bleeseri*	N			19	10					
29-1	*Eucalyptus tetrodonta*	N	10	15		10					
29-1	*Corymbia bleeseri*	N			19	10					
29-1	*Eucalyptus miniata*	N				5					
29-1	Dead tree sp.	N				5					
29-1	*Eucalyptus tetrodonta* (juvenile)	N						10			
29-1	*Eucalyptus* spp. (juvenile)	N						3		3	
29-1	Dead *Acacia* sp.	N						3			
29-1	*Planchonia careya*	N						3			
29-1	*Gardenia megasperma*	N						1		3	
29-1	*Calytrix exstipulata*	N						1			
29-1	*Persoonia falcata*	N						1			
29-1	*Heteropogon triticeus*	N								50	
29-1	*Petalostigma quadrioculare*	N								10	
29-1	*Eriachne triseta*	N								5	
31-1	*Eucalyptus tetrodonta*	N	13	16	15	10	10				
31-1	Dead *Eucalyptus miniata*	N	10	13	13	5					
31-1	*Eucalyptus miniata*	N	10	13	12	3					
31-1	*Corymbia bleeseri*	N				3	1				
31-1	*Corymbia porrecta*	N				1	3				
31-1	*Eucalyptus* sp.	N						8		8	
31-1	*Xanthostemon paradoxus*	N						3			
31-1	*Acacia mimula*	N						3			3
31-1	*Petalostigma quadrioculare*	N								3	
31-1	*Sorghum* sp.	N									3
31-1	*Buchanania obovata*	N									1
31-1	*Persoonia falcata*	N							1		
31-1	*Planchonia careya*	N							1		

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
31-1	*Gardenia megasperma*	N									1
31-1	*Eriachne triseta*	N									1
100-1	*Corymbia latifolia*	N	10	14	12	10		1		3	
100-1	*Wrightia saligna*	N				5					
100-1	*Corymbia porrecta*	N				1					
100-1	*Buchanania obovata*	N						1		10	
100-1	*Planchonia careya*	N						1		3	
100-1	*Hakea arborescens*	N						1			
100-1	*Pandanus spiralis*	N						1			
100-1	*Cochlospermum fraseri*	N						1			
100-1	*Sorghum* sp.	N								10	
100-1	*Eucalyptus* sp.	N								5	
101-1	*Corymbia bleeseri*	N				3				3	
101-1	*Eucalyptus tetrodonta*	N				3				3	
101-1	Dead trees	N				3					
101-1	*Xanthostemon paradoxus*	N				1		3		1	
101-1	*Corymbia porrecta*	N				1				3	
101-1	*Corymbia disjuncta*	N				1				1	
101-1	*Jacksonia dilatata*	N						5		1	
101-1	*Calytrix exstipulata*	N						5			
101-1	*Eucalyptus tetrodonta*	N						3		1	
101-1	*Acacia mimula*	N						3		1	
101-1	*Grevillea heliosperma*	N						3			
101-1	*Persoonia falcata*	N						1		1	
101-1	*Sorghum* sp.	N								20	
101-1	*Petalostigma quadrioculare*	N								5	
102-1	*Eucalyptus tetrodonta*	N	15	17	16	5					
102-1	*Wrightia saligna*	N	2	5	3.5			5		3	
102-1	*Acacia hemignosta*	N	3	4	3.5			3		10	
102-1	*Cochlospermum fraseri*	N	2	4	3			3			
102-1	*Sorghum* sp.	N	0.5	1	0.75					10	
102-1	*Corymbia disjuncta*	N	10	12	11		5			5	
102-1	*Petalostigma quadrioculare*	N	0.5	1	0.75					3	
102-1	*Eucalyptus* sp.	N	0.2	0.5	0.35					3	
105-1	*Corymbia latifolia*	N	10	12	11	10					
105-1	*Eucalyptus ?tectifica*	N	12	14	13	10					
105-1	*Dolichandrone filiformis*	N				1					
105-1	*Hakea arborescens*	N						20		3	
105-1	*Terminalia canescens*	N						5			
105-1	*Heteropogon triticeus*	N								30	
105-1	*Eriachne triseta*	N								20	
105-1	*Poaceae indent*	Y								10	

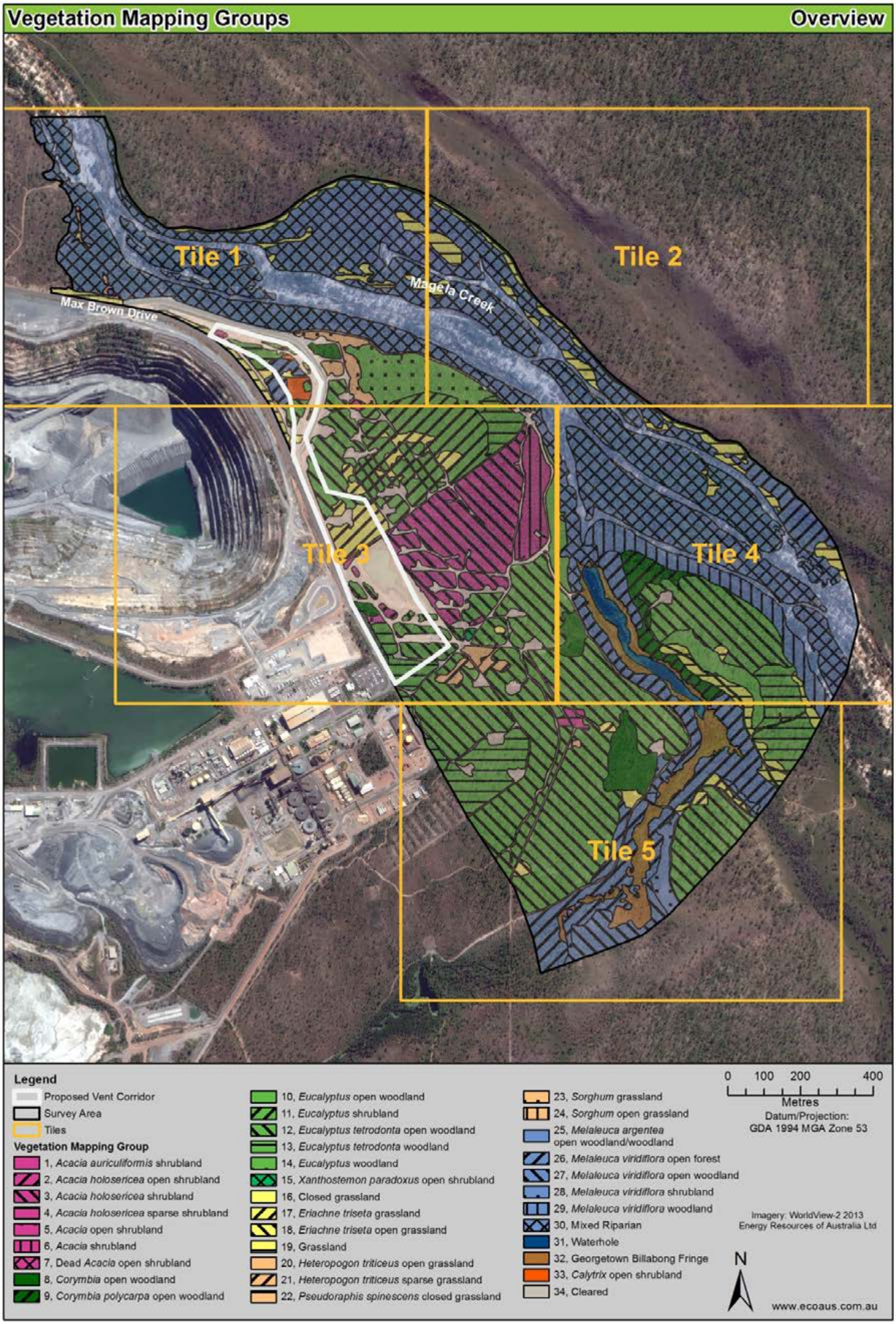
Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
105-1	*Spermacoce* sp.	N								5	
105-1	*Buchanania obovata*	N								3	
134-1	*Corymbia bleeseri*	N			14	3					
134-1	*Eucalyptus tetrodonta*	N			14	1					
134-1	*Acacia* dead	N			7			3			
134-1	*Xanthostemon paradoxus*	N			7			1			
134-1	*Eucalyptus* sp.	N			3			1			
134-1	*Sorghum* sp. (sterile)	N			1					40	
134-1	*Eriachne triseta*	N			0.5					20	
144-1A	*Melaleuca argentea*	N				5					
144-1A	*Syzygium forte*	N				5					
144-1A	*Pandanus spiralis*	N						3			
144-1A	*Syzygium armstrongii*	N						3			
144-1A	*Asteromyrtus symphocarpa*	N						3			
144-1A	*Germainia truncatiglumis*	N								3	
144-1A	*Ectrosia leporina*	N								3	
144-1A	*Chrysopogon oliganthus*	N								3	
144-1A	*Eriocaulon* sp.	N								3	
144-1A	*Xyris ?indica*	Y								1	
144-1A	*Utricularia fulva*	N								1	
144-1A	*Grevillea pteridifolia*	N								1	
144-1A	*Fimbristylis ?simplex*	N								1	
148-1	*Melaleuca viridiflora*	N	9	15	12	30		10			
148-1	*Lophostemon grandiflorus*	N			18	5					
148-1	*Asteromyrtus symphocarpa*	N				1					
148-1	*Pandanus spiralis*	N	2	4	3			5			
148-1	*Eriachne triseta*	N	1	1.2	1					20	
148-1	*Mnesithea rottboellioides*	Y								20	
148-1	*Fimbristylis ?simplex*	Y	0.1	0.2	0.1					5	
148-1	*Cyperus javanicus*	Y	1	1.2	1					5	
148-1	*Ectrosia* sp.	N								3	
148-1	*Germainia truncatiglumis*	Y	1	1.5	1.4					1	
148-1	*Panicum* sp.	N								1	
149-1	*Eucalyptus tetrodonta*	N				15					
149-1	Dead	N				5					
149-1	*Heteropogon triticeus*	N				1				3	
149-1	*Corymbia disjuncta*	Y				1					
149-1	*Corymbia dunlopiana*	N				1					
149-1	*Corymbia porrecta*	N				1					
149-1	*Eucalyptus* sp.	N						10		3	
149-1	*Xanthostemon paradoxus*	N						5		1	
149-1	*Planchonia careya*	N						5			

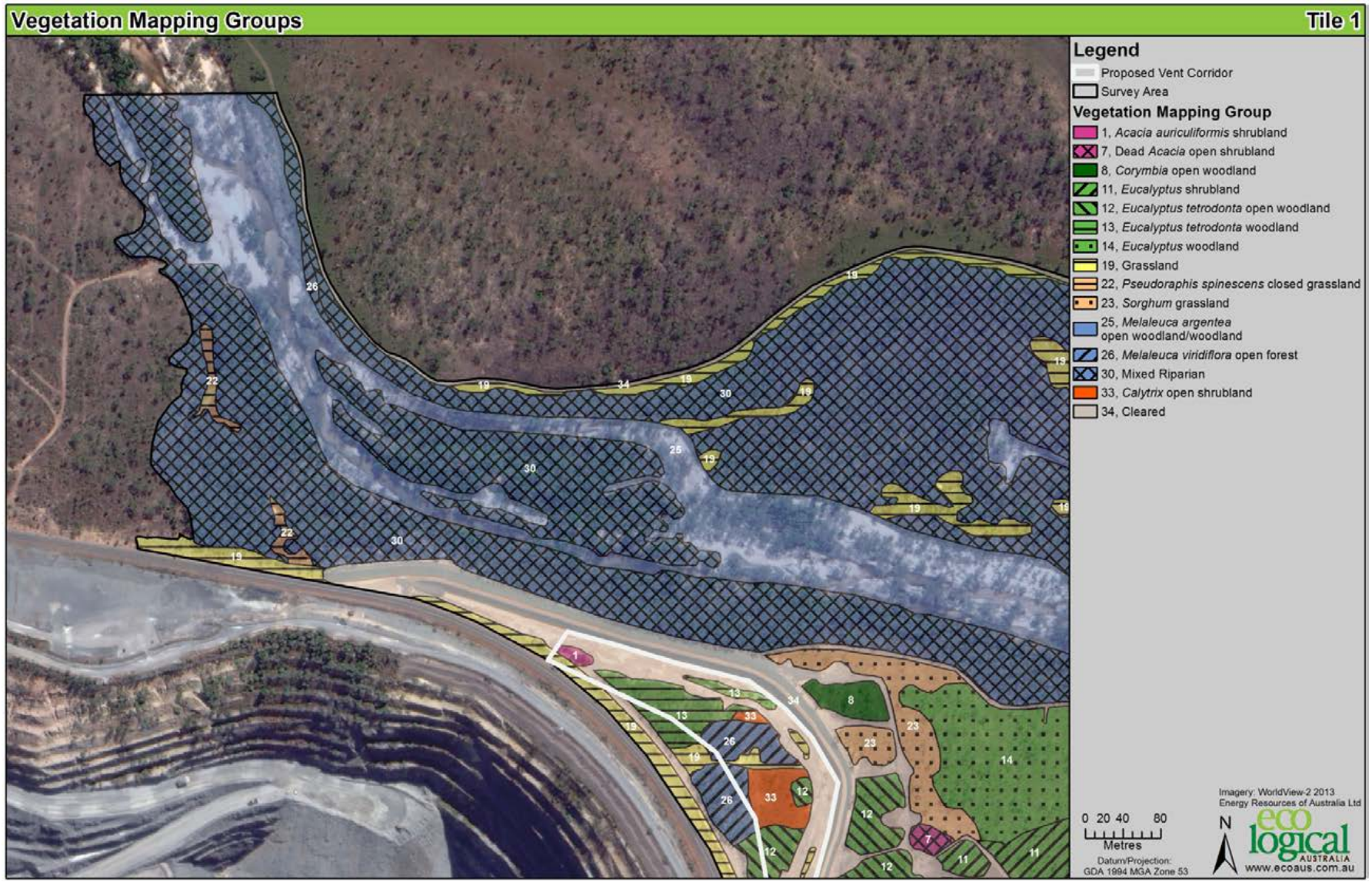
Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
149-1	*Acacia* dead	N						3			
149-1	*Acacia holosericea*	N						1		1	
149-1	*Flagellaria indica*	N						1			
149-1	*Petalostigma quadrioculare*	N								3	
149-1	*Pseudopogonatherum* sp.	Y								3	
149-1	*Acacia* sp.	N								1	
149-1	*Eriachne triseta*	Y								1	
149-1	*Setaria apiculata*	N								1	
149-1	*Gardenia megasperma*	N								1	
149-1	*Passiflora foetida*	N								1	
39-1	*Eucalyptus tetrodonta*	N	17	20	18	20		5		3	
39-1	*Eucalyptus miniata*	N	17	20	18	5					
39-1	Dead	N	10	12	10	3					
39-1	*Petalostigma quadrioculare*	N	0.8	1	1	1				3	
39-1	*Acacia mimula*	N	5	6	5			15		3	
39-1	*Acacia holosericea*	N	2	4	3			5		3	
39-1	*Calytrix exstipulata*	N	1	3	2			5		1	
39-1	*Cassytha* spp.	N						1			
39-1	*Jacksonia dilatata*	N						1			
39-1	*Acacia auriculiformis*	N						1			
39-1	*Acacia leptocarpa*	N						1			
39-1	*Eriachne triseta*	N		1	1					40	
39-1	*Dodonaea hispidula var. hispidula*	y	1	1.5	1					5	
39-1	*Ficus scobina*	N	1	2	1.5					1	
39-1	*Passiflora foetida*	N								1	
39-1	*Xanthostemon paradoxus*	N	5	7	7					1	
39-1	*Buchanania obovata*	N								1	
39-1	*Gardenia megasperma*	N								1	
39-1	*Corymbia porrecta*	N	7	12	10		10				
39-1	*Corymbia bleeseri*	N	7	9	8		1				
4 new	*Eucalyptus tetrodonta*	N	12	14	13	5		15			
4 new	*Acacia holosericea*	N	5	7	6			10			
4 new	*Xanthostemon paradoxus*	N	5	7	6			5			
4 new	*Heteropogon triticeus*	N	0.5	1.2	1					5	
40-1	*Eucalyptus tetrodonta*	N			18	30					
40-1	*Eucalyptus miniata*	N			18	10					
40-1	*Acacia difficilus*	N						20			
40-1	*Acacia hemignosta*	N						10			
40-1	*Acacia holosericea*	N						5			
40-1	Dead *Acacias (Fire)*	N						5			
40-1	*Heteropogon triticeus*	N								20	
40-1	*Eucalyptus* spp. (juvenile)	N								10	

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
40-1	*Dodonaea hispidula var. hispidula*	Y								1	
40-1	*Petalostigma quadrioculare*	N								1	
71-1B	*Melaleuca viridiflora*	N			20	35		5			
71-1B	*Eucalyptus alba var. australasica*	N			20	25					
71-1B	*Pandanus spiralis*	N						3			
71-1B	*Syzygium armstrongii*	N						3			
71-1B	*Mnesithea rottboellioides or Ischaemum* sp.	Y								50	
71-1B	*Germainia truncatiglumis*	Y								10	
71-1B	*Chrysopogon oliganthus*	Y								5	
71-1C	*Melaleuca viridiflora*	N	15	18	16	15					
71-1C	*Eucalyptus alba var. australasica*	N	18	20	19	10					
71-1C	*Acacia leptocarpa*	N				3					
71-1C	*Grevillea pteridifolia*	N				1					
71-1C	*Lophostemon lactifluus*	N				1					
71-1C	*Acacia* sp.	N				1					
71-1C	Dead *Acacia* sp.	N						8			
71-1C	*Pandanus spiralis*	N						3		5	
71-1C	*Barringtonia acutangula subsp. acutangula*	N						1			
71-1C	*Acacia holosericea*	N						1			
71-1C	*Germainia truncatiglumis*	Y								8	
71-1C	*Eriachne* sp.	N								5	
71-1C	*Ectrosia leporina*	N								1	
71-1C	*Eragrostis* sp.	N								1	
71-2A	*Acacia mimula*	N				15					
71-2A	*Acacia difficilus*	Y				10					
71-2A	*Acacia latescens*	Y				5					
71-2A	*Grevillea pteridifolia*	N				1					
71-2A	*Asteromyrtus symphyocarpa*	Y				1					
71-2A	*Jacksonia dilatata*	N						10			
71-2A	*Petalostigma pubescens*	N						5			
71-2A	*Calytrix achaeta*	N						3			
71-2A	*Syzygium suborbiculare*	N						1			
71-2A	*Sorghum* sp. (sterile)	N								25	
71-2A	*Eriachne triseta*	N								15	
72-1	*Eucalyptus tetrodonta*	N				10		3			
72-1	*Eucalyptus miniata*	N				5					
72-1	*Xanthostemon paradoxus*	N				1		8			
72-1	*Corymbia disjuncta*	N				1					
72-1	Dead treesp. - *emergents*	N				1					
72-1	*Acacia holosericea*	N						5			
72-1	*Alstonia actinophylla*	N						1			
82-1	Dead *Eucalyptus* sp.	N				3					

Site	*Species*	Collected	Height			% Cover					
			Lowest	Highest	Average	Upperstorey 1	Upperstorey 2	Midstorey 1	Midstorey 2	Groundstorey 1	Groundstory 2
82-1	*Corymbia porrecta*	N				1					
82-1	*Acacia holosericea*	N						60			
82-1	*Eucalyptus tetrodonta*	N						5			
82-1	*Planchonia careya*	N						3			
82-1	*Xanthostemon paradoxus*	N						3			
82-1	*Acacia* dead	N						3			
82-1	*Acacia auriculiformis*	N						1			
82-1	*Alstonia actinophylla*	N						1			
82-1	*Persoonia falcata*	N						1			
82-1	*Eucalyptus miniata*	N						1			
82-1	*Corymbia bleeseri*	N						1			
82-1	*Eriachne triseta*	N								30	
82-1	*Passiflora foetida*	N								3	
9_1	Dead *Eucalyptus species*	N				3					
9_1	*Eucalyptus tetrodonta*	N				1		5			
9_1	Dead tree	N				1					
9_1	Dead *Acacia*	N						10			
9_1	*Acacia holosericea*	N						1			
9_1	*Xanthostemon paradoxus*	N						1			
9_1	*Planchonia careya*	N						1			
9_1	*Eriachne triseta*	N								90	
9_1	*Ectrosia leporina*	N								10	

Appendix H: Detailed vegetation mapping


Vegetation Mapping Groups
Overview
Tile 1
Tile 2
Tile 3
Tile 4
Tile 5
Max Brown Drive
Magela Creek
Legend
Proposed Vent Corridor
Survey Area
Tiles
Vegetation Mapping Group
1, Acacia auriculiformis shrubland
2, Acacia holosericea open shrubland
3, Acacia holosericea shrubland
4, Acacia holosericea sparse shrubland
5, Acacia open shrubland
6, Acacia shrubland
7, Dead Acacia open shrubland
8, Corymbia open woodland
9, Corymbia polycarpa open woodland
10, Eucalyptus open woodland
11, Eucalyptus shrubland
12, Eucalyptus tetrodonta open woodland
13, Eucalyptus tetrodonta woodland
14, Eucalyptus woodland
15, Xanthostemon paradoxus open shrubland
16, Closed grassland
17, Eriachne triseta grassland
18, Eriachne triseta open grassland
19, Grassland
20, Heteropogon triticeus open grassland
21, Heteropogon triticeus sparse grassland
22, Pseudoraphis spinescens closed grassland
23, Sorghum grassland
24, Sorghum open grassland
25, Melaleuca argentea open woodland/woodland
26, Melaleuca viridiflora open forest
27, Melaleuca viridiflora open woodland
28, Melaleuca viridiflora shrubland
29, Melaleuca viridiflora woodland
30, Mixed Riparian
31, Waterhole
32, Georgetown Billabong Fringe
33, Calytrix open shrubland
34, Cleared
0 100 200 400
Metres
Datum/Projection:
GDA 1994 MGA Zone 53
Imagery: WorldView-2 2013
Energy Resources of Australia Ltd
N
www.ecoaus.com.au


Vegetation Mapping Groups
Tile 1
Legend
Proposed Vent Corridor
Survey Area
Vegetation Mapping Group
1, Acacia auriculiformis shrubland
7, Dead Acacia open shrubland
8, Corymbia open woodland
11, Eucalyptus shrubland
12, Eucalyptus tetrodonta open woodland
13, Eucalyptus tetrodonta woodland
14, Eucalyptus woodland
19, Grassland
22, Pseudoraphis spinescens closed grassland
23, Sorghum grassland
25, Melaleuca argentea open woodland/woodland
26, Melaleuca viridiflora open forest
30, Mixed Riparian
33, Calytrix open shrubland
34, Cleared
0 20 40 80
Metres
Datum/Projection:
GDA 1994 MGA Zone 53
Imagery: WorldView-2 2013
Energy Resources of Australia Ltd
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eco logical AUSTRALIA
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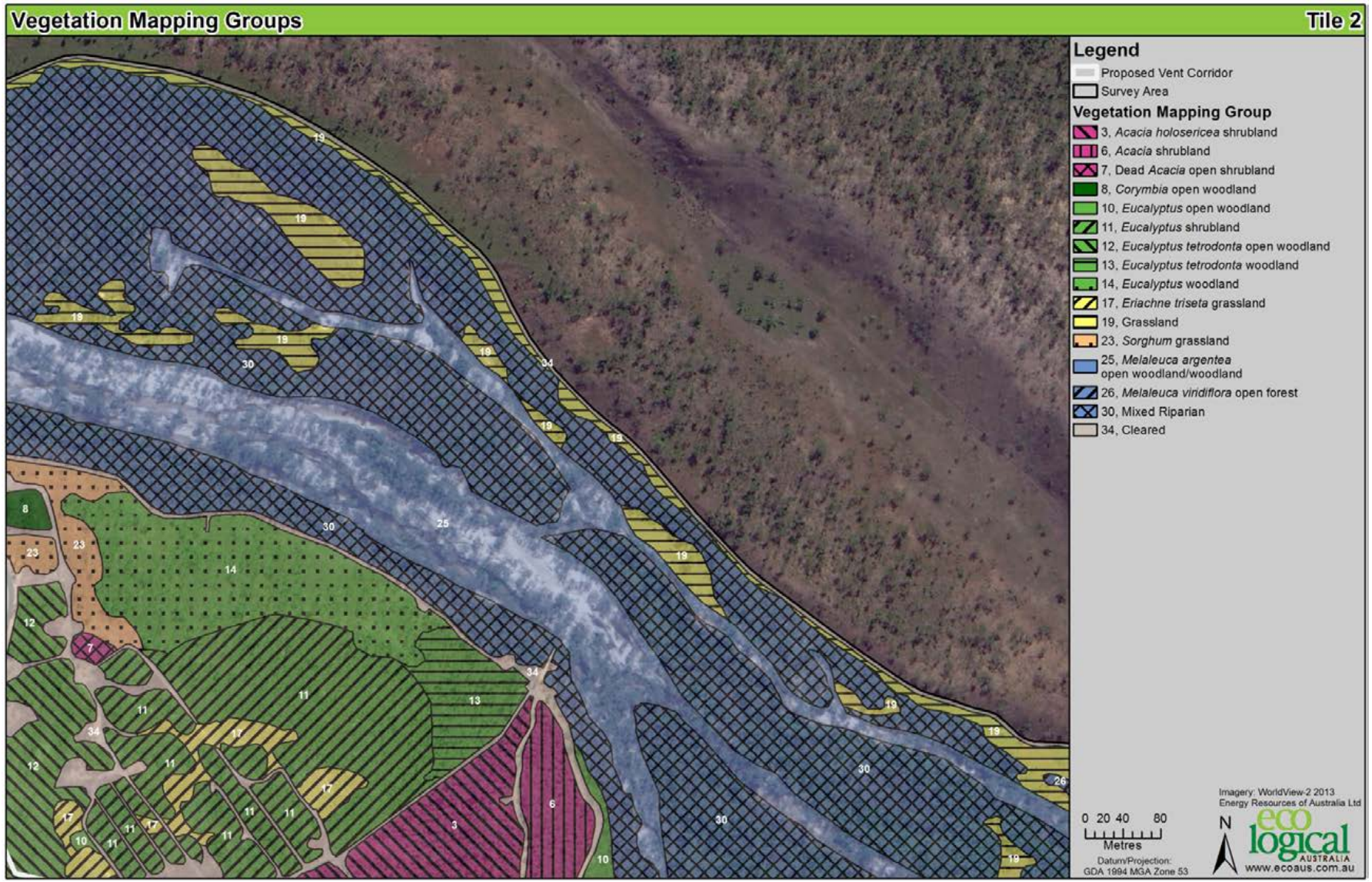
Vegetation Mapping Groups
Tile 2
Legend
Proposed Vent Corridor
Survey Area
Vegetation Mapping Group
3, Acacia holosericea shrubland
6, Acacia shrubland
7, Dead Acacia open shrubland
8, Corymbia open woodland
10, Eucalyptus open woodland
11, Eucalyptus shrubland
12, Eucalyptus tetrodonta open woodland
13, Eucalyptus tetrodonta woodland
14, Eucalyptus woodland
17, Eriachne triseta grassland
19, Grassland
23, Sorghum grassland
25, Melaleuca argentea open woodland/woodland
26, Melaleuca viridiflora open forest
30, Mixed Riparian
34, Cleared
Imagery: WorldView-2 2013
Energy Resources of Australia Ltd
0 20 40 80
Metres
Datum/Projection:
GDA 1994 MGA Zone 53
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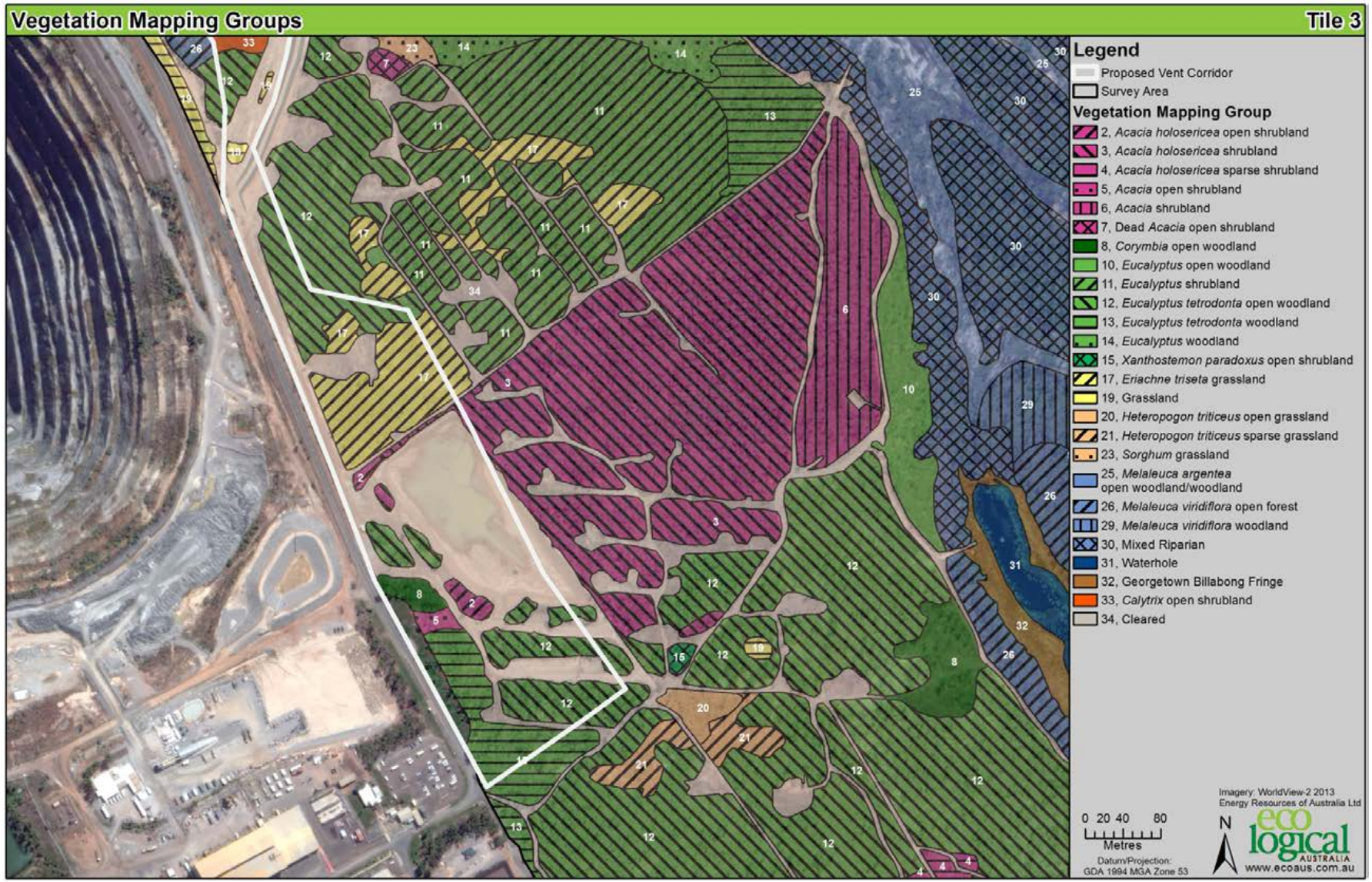
Vegetation Mapping Groups
Tile 3
Legend
Proposed Vent Corridor
Survey Area
Vegetation Mapping Group
2, Acacia holosericea open shrubland
3, Acacia holosericea shrubland
4, Acacia holosericea sparse shrubland
5, Acacia open shrubland
6, Acacia shrubland
7, Dead Acacia open shrubland
8, Corymbia open woodland
10, Eucalyptus open woodland
11, Eucalyptus shrubland
12, Eucalyptus tetrodonta open woodland
13, Eucalyptus tetrodonta woodland
14, Eucalyptus woodland
15, Xanthostemon paradoxus open shrubland
17, Eriachne triseta grassland
19, Grassland
20, Heteropogon triticeus open grassland
21, Heteropogon triticeus sparse grassland
23, Sorghum grassland
25, Melaleuca argentea open woodland/woodland
26, Melaleuca viridiflora open forest
29, Melaleuca viridiflora woodland
30, Mixed Riparian
31, Waterhole
32, Georgetown Billabong Fringe
33, Calytrix open shrubland
34, Cleared
0 20 40 80
Metres
Datum/Projection:
GDA 1994 MGA Zone 53
Imagery: WorldView-2 2013
Energy Resources of Australia Ltd
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eco logical AUSTRALIA
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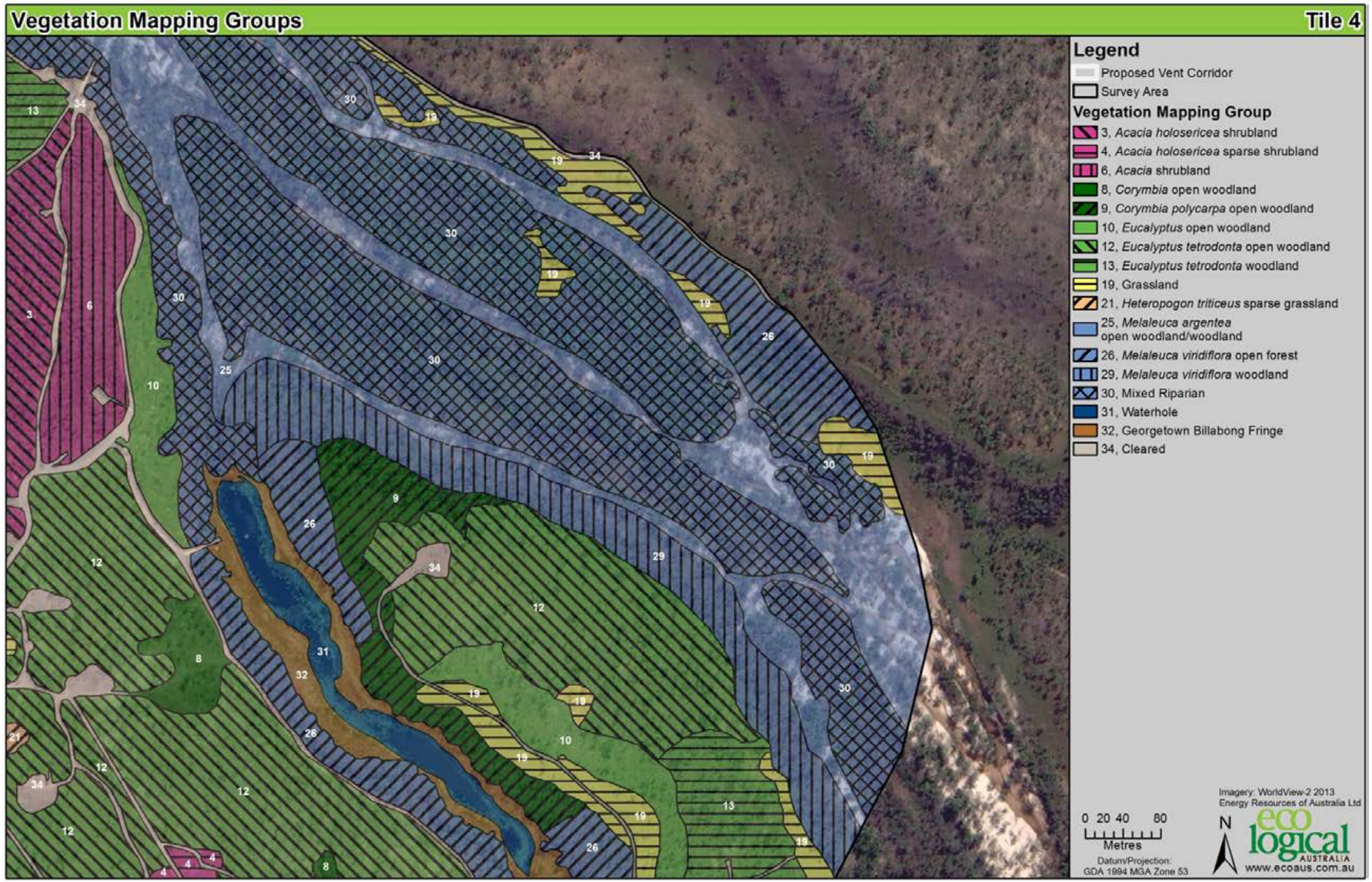
Vegetation Mapping Groups
Tile 4
Legend
Proposed Vent Corridor
Survey Area
Vegetation Mapping Group
3, Acacia holosericea shrubland
4, Acacia holosericea sparse shrubland
6, Acacia shrubland
8, Corymbia open woodland
9, Corymbia polycarpa open woodland
10, Eucalyptus open woodland
12, Eucalyptus tetrodonta open woodland
13, Eucalyptus tetrodonta woodland
19, Grassland
21, Heteropogon triticeus sparse grassland
25, Melaleuca argentea open woodland/woodland
26, Melaleuca viridiflora open forest
29, Melaleuca viridiflora woodland
30, Mixed Riparian
31, Waterhole
32, Georgetown Billabong Fringe
34, Cleared
0 20 40 80
Metres
Datum/Projection:
GDA 1994 MGA Zone 53
Imagery: WorldView-2 2013
Energy Resources of Australia Ltd
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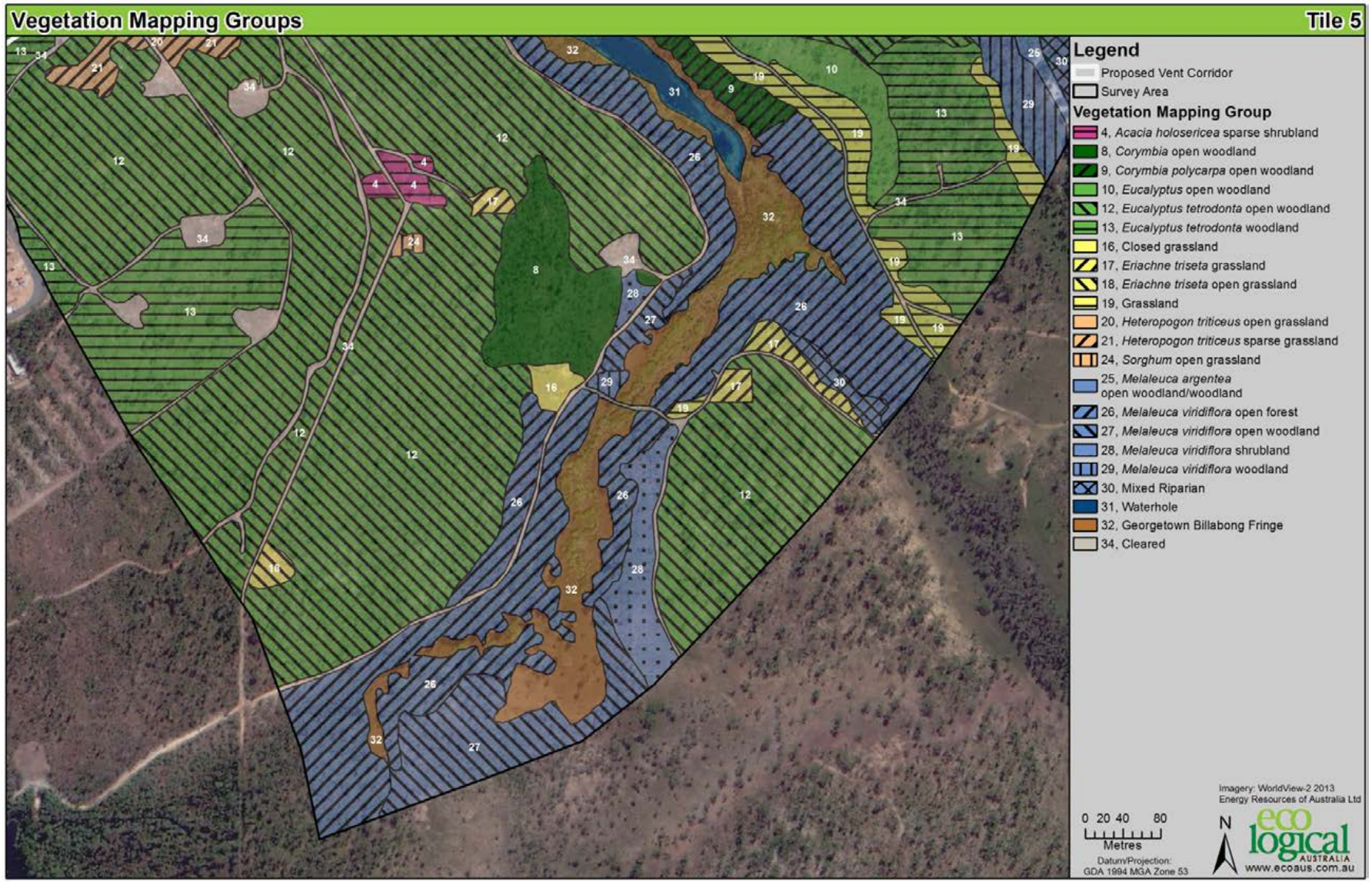
Vegetation Mapping Groups
Tile 5
Legend
Proposed Vent Corridor
Survey Area
Vegetation Mapping Group
4, Acacia holosericea sparse shrubland
8, Corymbia open woodland
9, Corymbia polycarpa open woodland
10, Eucalyptus open woodland
12, Eucalyptus tetrodonta open woodland
13, Eucalyptus tetrodonta woodland
16, Closed grassland
17, Eriachne triseta grassland
18, Eriachne triseta open grassland
19, Grassland
20, Heteropogon triticeus open grassland
21, Heteropogon triticeus sparse grassland
24, Sorghum open grassland
25, Melaleuca argentea open woodland/woodland
26, Melaleuca viridiflora open forest
27, Melaleuca viridiflora open woodland
28, Melaleuca viridiflora shrubland
29, Melaleuca viridiflora woodland
30, Mixed Riparian
31, Waterhole
32, Georgetown Billabong Fringe
34, Cleared
Imagery: WorldView-2 2013
Energy Resources of Australia Ltd
0 20 40 80
Metres
Datum/Projection:
GDA 1994 MGA Zone 53
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APPENDIX I: VEGETATION MAPPING GROUP DESCRIPTIONS, HABITATS AND CONDITIONS

(FIRE-AFFECTED) TERRESTRIAL VEGETATION MAPPING GROUPS	
8 - *Corymbia* open woodland	
Description:	A broad group that includes all vegetation communities dominated by *Corymbia* species, including: (4) *Corymbia bleeseri*, *Xanthostemon paradoxus* mid open woodland with a *Eucalyptus* sp. *Buchanania obovata*, *Jacksonia dilatata* tall sparse shrubland in the midstorey and *Sorghum* sp. *Petalostigma quadrioculare*, *Eucalyptus* sp mid sparse grassland in the understorey. (103) *Corymbia foelscheana*, *Wrightia saligna* mid open woodland with a dead *Acacia* sp., *Pandanus spiralis*, *Buchanania obovata* tall sparse shrubland in the midstorey and *Eriachne triseta*, *Sorghum* sp. and *Pandanus spiralis* mid open grassland in the understorey
Habitat:	Terrestrial, lowland country
Condition in survey area:	VAST rating: residual; evidence of frequent burning
9 - *Corymbia polycarpa* open woodland	
Description:	(120) *Corymbia polycarpa*, *Melaleuca cajaputi*, *Terminalia erythrocarpa*, *Eucalyptus alba* mid open woodland with a *Mnesithia rottboellidiodes* mid grassland
Habitat:	Transition zone between riparian and terrestrial, species tolerant of wetter conditions, may get flooded for short periods
Condition in survey area:	VAST rating: residual; evidence of infrequent burning
10, 14 *Eucalyptus* open woodland / woodland	
Description:	A broad group that includes all *Eucalyptus* woodlands not dominated by *E. tetrodonta* (*E. tetrodonta* still present) for example: (9 new) *Eucalyptus miniata* (Darwin Woolybutt), *Terminalia erythrocarpa, Eucalyptus tetrodonta* (Darwin Stringybark) mid open woodland with *Eucalyptus* spp., dead shrubs, *Pandanus spiralis* tall sparse shrubland in the midstorey and *Sorghum* sp.mid sparse grassland in the understorey
Habitat:	Terrestrial, lowland country, presence of *Terminalia erythrocarpa* indicates wetter conditions
Condition in survey area:	VAST rating: residual; evidence of infrequent fires
12, 13 *Eucalyptus tetrodonta* woodland / open woodland	
Description:	*Eucalyptus tetrodonta* (Darwin Stringybark), *E. miniata* (Darwin Woolybutt), *Corymbia bleeseri* mid woodland or open woodland with a tall sparse / open shrubland of young *Eucalyptus* sp, *Acacia* sp and *Xanthostemon paradoxus* in the midstorey and a mid-open grassland of *Eriachne trisecta, Heteropogon triticeus* and *Petalostigma quadrioculare* in the understorey.
Habitat:	Terrestrial, lowland country
Condition in survey area:	VAST rating: residual; evidence of infrequent fires
DISTURBED TERRESTRIAL MAPPING GROUPS	
1 *Acacia auriculiformis* shrubland	

Description:	Advanced regrowth after disturbance (54 new) *Acacia auriculiformis* tall shrubland Very small patch, surrounded by tracks and separated by bund walls from surrounding environment
Habitat:	Terrestrial, lowland country
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth, fragmented, small patch, separated by bund walls
2, 3, 4 *Acacia holosericea* shrubland / open shrubland / sparse shrubland	
Description:	Advanced regrowth after disturbance, typically with: (72) Dead *Eucalyptus* sp., *Corymbia porrecta* mid isolated trees with *Acacia holosericea*, *Eucalyptus tetrodonta*, dead *Acacia* sp. tall shrubland in the midstorey and *Eriachne triseta*, *Passiflora foetida* mid open grassland Vegetation mapping unit is interspersed with smaller patches of *E. tetrodonta*, *Planchonia careya* tall shrubland
Habitat:	Terrestrial, hill side and lowland country
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after irrigation, fire, and partial clearing (exploration)
5 *Acacia* open shrubland	
Description:	Advanced regrowth after disturbance. Broader group with *Acacia holosericea* present but not dominant, for example: (39_2) *Acacia holosericea*, *Acacia lacertensis*, *Calytrix exstipulata* tall open shrubland in the mid storey and *Eriachne triseta*, *Melinis repens* mid open grassland in the understorey
Habitat:	Terrestrial, lowland country, crest
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after irrigation, fire, and partial clearing (exploration)
6 *Acacia* shrubland	
Description:	Advanced regrowth: (27) Dead *Eucalyptus* mid isolated trees with an *Acacia oncinocarpa*, *Acacia holosericea*, *Eucalyptus tetrodonta*, *Eucalyptus miniata* tall shrubland midstorey and *Sorghum* sp., *Petalostigma quadrioculare*, *Calytrix exstipulata*, *Eriachne triseta* mid sparse grassland understorey
Habitat:	Terrestrial, lowland country, lower slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after irrigation, fire, and partial clearing (exploration)
7 Dead *Acacia* open shrubland	
Description:	Small patch of advanced regrowth: (79) Dead *Eucalyptus* sp. mid isolated trees with dead *Acacia* sp, *Acacia holosericea, Xanthostemon paradoxus, E. tetrodonta* tall open shrubland midstorey and *Eriachne triseta, Ectrosia leporina* mid open grassland in the understorey

Habitat:	Terrestrial, lowland country, mid slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after irrigation, fire, and partial clearing (exploration). A 2012 fire may have killed *Acacia* sp.
33 *Calytrix* open shrubland	
Description:	Regrowth: (7 new) *Calytrix exstipulata* (Turkey Bush) mid open shrubland in the midstorey and *Sorghum* sp. mid grassland in the understorey
Habitat:	Terrestrial, lowland country, lower slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after clearing, surrounded by bund walls
11 *Eucalyptus* shrubland	
Description:	Regrowth after disturbance with a patchy distribution of: (9_1) Dead *Eucalyptus sp*. mid isolated trees with *Eucalyptus tetrodonta*, dead *Acacia* sp. tall shrubland midstorey (9_2) Dead *Eucalyptus* sp. mid isolated trees with *Eriachne triseta, Ectrosia leporina* mid closed grassland
Habitat:	Terrestrial, lowland country, upper-mid slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after irrigation, fire, and partial clearing (exploration)
15 *Xanthostemon paradoxus* open shrubland	
Description:	(5 new) *Eucalyptus tetrodonta, Corymbia porrecta* isolated trees with *Xanthostemon paradoxus*, *Calytrix exstipulata* (Turkey Bush), *Acacia holosericea* tall open shrubland in the midstorey and *Eriachne triseta*, *Heteropogon triticeus* mid sparse grassland in the understorey
Habitat:	Terrestrial, lowland country, upper-mid slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after irrigation, fire, and partial clearing (exploration)
16 Closed grassland	
Description:	Regrowth after disturbance / clearing with a dominant grass understorey, for example: (2 new) Grass sp., *Eriachne triseta* mid closed grassland in the understorey
Habitat:	Terrestrial, lowland country, upper-mid slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after clearing with native grass species.
17, 18 *Eriachne triseta* grassland / open grassland	

Description:	Regrowth after disturbance / clearing with a dominant grass understorey, for example: (41) *Corymbia bleeseri*, *Eucalyptus tetrodonta*, *Planchonia careya* low isolated trees with *Acacia holosericea*, *Eucalyptus* sp.mid sparse shrubland in the midstorey and *Eriachne triseta*, *Eriachne* sp. mid grassland in the understorey
Habitat:	Terrestrial, lowland country, upper-mid slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after clearing with native grass species.
20, 21*Heteropogon triticeus* open grassland / sparse grassland	
Description:	Regrowth after clearing: (128) *Eucalyptus tetrodonta*, dead trees, *Xanthostemon paradoxus* mid isolated trees with *Xanthostemon paradoxus*, *Corymbia dunlopiana*, *Eucalyptus tetrodonta* low sparse shrubland in the midstorey and *Heteropogon triticeus* mid open grassland in the understorey
Habitat:	Terrestrial, lowland country
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after clearing with native grass species.
23, 24 *Sorghum* grassland / open grassland	
Description:	Some areas are regrowth after clearing or may have been heavily impacted by fire, for example: (134_1) *Eucalyptus tetrodonta, Corymbia bleeseri* mid isolated trees with dead *Acacia* sp., *Xanthostemon paradoxus, Eucalyptus* sp.mid isolated shrubs in the midstorey and *Sorghum* sp, *Eriachne triseta* mid grassland in the understorey
Habitat:	Terrestrial, lowland country, mid-lower slope
Condition in survey area:	VAST rating: transformed; vegetation structure and composition significantly altered. Regrowth after clearing and / or fire with native grass species.
RIPARIAN MAPPING GROUPS	
25 *Melaleuca argentea* woodland / open woodland	
Description:	*Melaleuca argentea* (Silver-leaved Paperbark) mid woodland / open woodlands Also occurring: *Syzygium forte*, *Lophopetalum arnhemicum*, *Lophostemon grandiflorus*. Generally no mid or understorey present.
Habitat:	Sandy creek bed of Magela Creek
Condition in survey area:	TRARC rating: excellent; some minor disturbance from pigs and fire
26, 27, 28, 29 *Melaleuca viridiflora* open forest / open woodland / shrubland / woodland	
Description:	*Melaleuca viridiflora* (Broad-leaved Paperbark) mid to low open forests / woodlands / open woodlands and shrublands typically with isolated *Pandanus spiralis* palms in the midstorey and *Mnesithea rottboellioides* (Northern Cane grass), *Germania truncatiglumis* mid grassland in the understorey
Habitat:	Typically found in the riparian zone of Magela Creek, especially in the wetter more frequently inundated areas and around Georgetown billabong

Condition in survey area:	TRARC rating: excellent; some minor disturbance from pigs and fire
22 *Pseudoraphis spinescens* closed grassland	
Description:	*Pseudoraphis spinescens*, *Persicaria attenuata* low closed grassland
Habitat:	Ephemeral creek bed
Condition in survey area:	TRARC rating: excellent; some minor disturbance from pigs and fire
19 Grassland	
Description:	(89) *Melaleuca viridiflora, Corymbia polycarpa* mid isolated trees with *Pandanus spiralis* tall isolated palms in the mid storey and grass sp. (*Poacea indent*) mid grassland in the understorey (54) regrowth at bottom of bund wall
Habitat:	Riparian and transition zone between riparian and terrestrial habitats
Condition in survey area:	TRARC rating: excellent; some minor disturbance from pigs and fire
30 Mixed riparian	
Description:	Mixed riparian: The channels support a variety of vegetation communities, depending on elevation and hence levels, frequency and duration of inundation by the ephemeral Magela Creek. *Melaleuca* viridiflora open forest (see vegetation mapping group description above) *Melaleuca viridiflora* woodland / open woodland *Melaleuca viridiflora* closed shrubland / shrubland *Eucalyptus alba* open woodland *Jacksonia* open shrubland *Acacia* mid woodland Grasslands (see vegetation mapping group description above)
Habitat:	Riparian habitats, undulating dune systems
Condition in survey area:	TRARC rating: excellent; some minor disturbance from pigs and fire

Note: see Thackway and Lesslie (2005) for VAST rating and Dixon et al. (2006) for TRARC rating

APPENDIX J: FLORA SPECIES LIST

Family	Species
Anacardiaceae	*Buchanania obovata*
Apocynaceae	*Alstonia actinophylla* *Wrightia saligna*
Arecaceae	*Livistona humilis*
Bignoniaceae	*Dolichandrone filiformis*
Caesalpiniaceae	*Erythrophleum chlorostachys*
Cochlospermaceae	*Cochlospermum fraseri*
Combreataceae	*Terminalia canescens* *Terminalia erythrocarpa*
Cyperaceae	*Cyperus javanicus* *Fimbristylis ?simplex*
Dilleneaceae	*Hibbertia juncea* *Hibbertia* sp.
Eriocaulaceae	*Eriocaulon* sp.
Fabaceae	*Jacksonia dilatata*
Flagellariaceae	*Flagellaria indica*
Lauraceae	*Cassytha* sp.
Lecythidaceae	*Barringtonia acutangula acutangula* *Planchonia careya*
Lentibulariaceae	*Utricularia fulva*
Malvaceae	*Hibiscus* sp.
Mimosacaea	*Acacia latescens* *Acacia auriculiformis* *Acacia difficilus* *Acacia hemignosta* *Acacia holosericea* *Acacia lacertensis*

Family	Species
Mimosacaea	*Acacia leptocarpa*
	Acacia mimula
	Acacia oncinocarpa
	Acacia sp.
Moraceae	*Ficus scobina*
Myrtaceae	*Asteromyrtus symphyocarpa*
	Calytrix achaeta
	Calytrix exstipulata
	Corymbia bleeseri
	Corymbia disjuncta
	Corymbia dunlopiana
	Corymbia foelscheana
	Corymbia latifolia
	Corymbia porrecta
	Eucalyptus ?tectifica
	Eucalyptus alba var. australasica
	Eucalyptus miniata
	Eucalyptus sp.
	Eucalyptus tetrodonta
	Lophostemon grandiflorus
	Lophostemon lactifluus
	Melaleuca argentea
	Melaleuca dealbata
	Melaleuca leucadendra
	Melaleuca viridiflora
	Syzygium armstrongii
	Syzygium forte

Family	Species
	Syzygium sp.
Myrtaceae	*Syzygium suborbiculare*
	Xanthostemon paradoxus
Pandanaceae	*Pandanus spiralis*
Passifloraceae	*Passiflora foetida*
Picrodendraceae	*Petalostigma pubescens*
	Petalostigma quadrioculare
Poaceae	*Aristida* sp.
	Cenchrus polystachios
	Chrysopogon oliganthus
	Ectrosia leporina
	Ectrosia sp.
	Eragrostis sp.
	Eriachne sp. (sterile)
	Eriachne triseta
	Heteropogon triticeus
	Mnesithea rottboellioides
	Mnesithea rottboellioides or *Ischaemum* sp.
	Panicum sp.
	Poaceae indent
	Pseudopogonatherum sp.
	Setaria apiculata
	Setaria sp.
	Sorghum ?plumosum
	Sorghum sp.
Proteaceae	*Germainia truncatiglumis*
	Grevillea heliosperma

Family	Species
	Grevillea pteridifolia *Grevillea* sp.
Proteaceae	*Hakea arborescens* *Persoonia falcata*
Restionaceae	*Leptocarpus spathaceus*
Rhizophoraceae	*Carallia brachiata*
Rubiaceae	*Gardenia megasperma* *Spermacoce* sp.
Sapindaceae	*Dodonaea hispidula var. hispidula*
Sterculiaceae	*Waltheria* sp.
Xyridaceae	*Xyris ?indica*

APPENDIX K: FAUNA SPECIES IDENTIFIED IN THE 2013 SURVEY

Locations: GB = Georgetown Billabong, RP1 = Retention pond 1, MC = Magela Creek

Record type: B = bird census, C = cage trap, E = A Elliott trap, F = funnel trap, N = nocturnal survey, O = Observation, P = Photographed, ** = breeding pair

Species	Trapping transects						Camera transects					Wetland surveys			Nocturnal surveys						Diurnal		Incidental + other surveys	Acoustic survey
	A + Noct. 6	B	C	D + L + Noct. 6	E	F	G	H	I	J	K	GB + Noct. 3	RP 1	MC	1	2	5	7	8	9	1	2		
Amphibians																								
Bilingual Froglet (*Crinia bilingua*)																						O		
Dahl's Aquatic Frog (*Litoria dahlii*)																								
Northern Dwarf Tree-frog (*Litoria bicolor*)																						O	O	
Peters' Frog (*Litoria inermis*)																								
Red Tree-frog (*Litoria rubella*)																							O	
Rocket Frog (*Litoria nasuta*)												N											O	
Roth's Tree-frog (*Litoria rothii*)												N											O	
Wotjulum Frog (*Litoria wotjulumensis*)																							O	
Birds																								
Australasian Darter (*Anhinga novaehollandiae*)												W	W											
Australasian Figbird (*Sphecotheres vieilloti*)	B				B																		O	
Australian Owlet-nightjar (*Aegotheles cristatus*)	N																							
Australian Pelican (*Pelecanus conspicillatus*)												W											O	
Australian White Ibis (*Threskiornis molucca*)												W												
Barking Owl (*Ninox connivens*)	N			N								N					N						O	
Bar-shouldered Dove (*Geopelia humeralis*)	B	B	B		B	B				P		W	W	W							O	O	O	
Black Kite (*Milvus migrans*)													W										O	
Black-faced Cuckoo-shrike (*Coracina novaehollandiae*)	B		B		B							W											O	
Black-necked Stork(Ephippiorhynchus asiaticus)		B										W	W	W									O	
Black-tailed Treecreeper (*Climacteris melanura*)			B	B								W												
Black-winged Stilt (Himantopus himantopus)												W	W											

Species	Trapping transects						Camera transects					Wetland surveys			Nocturnal surveys						Diurnal		Incidental + other surveys	Acoustic survey
	A + Noct. 6	B	C	D + L + Noct. 6	E	F	G	H	I	J	K	GB + Noct. 3	RP 1	MC	1	2	5	7	8	9	1	2		
Blue-winged Kookaburra (*Dacelo leachii*)					B	B	P		P			W, N									O	O		
Brown Falcon (*Falco berigora*)																					O			
Brown Goshawk (*Accipiter fasciatus*)																							O	
Brown Honeyeater (*Lichmera indistincta*)					B									W									O	
Bush Stone-curlew (*Burhinus grallarius*)								P		P		N											O	
Cattle Egret (*Ardea ibis*) MIGRATORY												W												
Comb-crested Jacana (*Irediparra gallinacea*)												W	W											
Diamond Dove (*Geopelia cuneata*)					B							N												
Dollarbird (*Eurystomus orientalis*)												W												
Double-barred Finch (*Taeniopygia bichenovii*)	B			B	B	B				P		W											O	
Dusky Honeyeater (*Myzomela obscura*)												W									O			
Eastern Great Egret (*Ardea modesta*) MIGRATORY												W	W											
Forest Kingfisher (*Todiramphus macleayii*)												W											O	
Glossy Ibis (*Plegadis falcinellus*)												W	W											
Green Pygmy-Goose (*Nettapus pulchellus*)												W	W											
Grey Shrike-thrush (*Colluricincla harmonica*)			B																					
Grey-crowned Babbler (*Pomatostomus temporalis*)			B																				O	
Helmeted Friarbird (*Philemon buceroides*)																					O			
Intermediate Egret (*Ardea intermedia*)												W	W											
Little Black Cormorant (*Phalacrocorax sulcirostris*)												W	W											
Little Corella (*Cacatua sanguinea*)	B	B										W	W										O	

Species	Trapping transects						Camera transects					Wetland surveys			Nocturnal surveys						Diurnal		Incidental + other surveys	Acoustic survey
	A + Noct. 6	B	C	D + L + Noct. 6	E	F	G	H	I	J	K	GB + Noct. 3	RP 1	MC	1	2	5	7	8	9	1	2		
Little Egret (*Egretta garzetta*)												W												
Little Kingfisher (*Ceyx pusilla*)																							O	
Little Pied Cormorant (*Microcarbo melanoleucos*)												W	W											
Magpie Goose (*Anseranas semipalmata*)												W, N	W											
Magpie-lark(*Grallina cyanoleuca*)					B																			
Masked Lapwing (*Vanellus miles*)												W, N	W											
Mistletoebird (*Dicaeum hirundinaceum*)				B																				
Nankeen Kestrel (*Falco cenchroides*)	B																							
Nankeen Night Heron (*Nycticorax caledonicus*)												W, N		W										
Pacific Black Duck (*Anas superciliosa*)												W	W											
Partridge Pigeon(*Geophaps smithii*) EPBC VULNERABLE NT VULNERABLE																							O x 2	
Peaceful Dove (*Geopelia striata*)									P	P	P	W		W									O	
Pheasant Coucal (*Centropus phasianinus*)									P	P		W											O	
Pied Butcherbird (*Cracticus nigrogularis*)																					O			
Pied Cormorant (*Phalacrocorax varius*)												W												
Pied Heron (*Egretta picata*)												W												
Plumed Whistling-Duck (*Dendrocygna eytoni*)												W, N	W											
Radjah Shelduck (*Tadorna radjah*)												W, N	W											
Rainbow Bee-eater (*Merops ornatus*) MIGRATORY	B	B	B		B	B			P			W		W							O		O	
Rainbow Lorikeet (*Trichoglossus haematodus*)		B	B	B	B	B						W		W							O	O	O	
Red-backed Fairy-wren (*Malurus melanocephalus*)				B																				
Red-tailed Black-cockatoo (*Calyptorhynchus banksii*)			B		B	B						W									O		O	
Red-winged Parrot (*Aprosmictus erythropterus*)			B	B								W											O	

Species	Trapping transects						Camera transects					Wetland surveys			Nocturnal surveys						Diurnal		Incidental + other surveys	Acoustic survey
	A + Noct. 6	B	C	D + L + Noct. 6	E	F	G	H	I	J	K	GB + Noct. 3	RP 1	MC	1	2	5	7	8	9	1	2		
Restless Flycatcher (*Myiagra inquieta*)												W												
Royal Spoonbill (*Platalea regia*)												W		W									O	
Rufous Whistler (*Pachycephala rufiventris*)			B																					
Sacred Kingfisher (*Todiramphus sanctus*)												W												
Silver-crowned Friarbird (*Philemon argenticeps*)		B	B	B	B	B						W									O	O	O	
Spangled Drongo (*Dicrurus bracteatus*)																					O		O	
Spotted Nightjar (*Eurostopodus argus*)												N												
Straw-necked Ibis (*Threskiornis spinicollis*)												W												
Sulphur-crested Cockatoo (*Cacatua galerita*)												W		W							O	O	O	
Tawny Frogmouth (*Podargus strigoides*)						B						N							N				O	
Torresian Crow (*Corvus orru*)				B	B			P	P	P		W												
Varied Lorikeet (*Psitteuteles versicolor*)												W												
Weebill (*Smicrornis brevirostris*)			B		B									W										
Whistling Kite (*Haliastur sphenurus*)	B	B		B	B	B						W	W								O		O	
White-bellied Cuckoo-shrike (*Coracina papuensis*)					B							W		W							O			
White-bellied Sea-eagle (*Haliaeetus leucogaster*) MIGRATORY												W**											O	
White-faced Heron (*Egretta novaehollandiae*)												W												
White-gaped Honeyeater (*Lichenostomus unicolor*)		B	B	B		B															O			
White-necked Heron (*Ardea pacifica*)												W												
White-winged Triller (*Lalage sueurii*)	B	B																						
Willie Wagtail (*Rhipidura leucophrys*)	B	B	B	B, P	B	B						W	W	W							O	O		
Yellow Oriole (*Oriolus flavocinctus*)		B	B	B	B	B						W										O	O	
Yellow-billed Spoonbill (*Platalea flavipes*)																							O	

Species	Trapping transects						Camera transects					Wetland surveys			Nocturnal surveys						Diurnal		Incidental + other surveys	Acoustic survey
	A + Noct. 6	B	C	D + L + Noct. 6	E	F	G	H	I	J	K	GB + Noct. 3	RP 1	MC	1	2	5	7	8	9	1	2		
Introduced																								
Cane Toad (*Rhinella marina*)			F	C, P					P		P	N									O		O	
Cat (*Felis catus*)										P														
Pig (*Sus scrofa*)												W, N										O	N, O	
Mammals																								
Agile Wallaby (*Macropus agilis*)				P			P	P	P	P	P	W, N											O	
Black Flying-fox (*Pteropus alecto*)												N												
Common Brushtail Possum (*Trichosurus vulpecula*)				P			P	P	P	P														
Dingo (*Canis lupus*)				P					P	P													O	
Fawn Antechinus (*Antechinus bellus*) NT ENDANGERED	E							P		P														
Grassland Melomys (*Melomys burtoni*)		2 x E																						
Little Red Flying-fox (*Pteropus scapulatus*)												N												
Northern Brown Bandicoot (*Isoodon macrourus*)				P	C		P	P	P	P														
Reptiles																								
Burton's Legless Lizard (*Lialis burtonis*)		F																						
Bynoe's Gecko (*Heteronotia binoei*)				2 x F													N			N				
Freshwater Crocodile (*Crocodylus johnstoni*)												N												
Green Tree Snake (*Dendrelaphis punctulata*)												N												
Keelback (*Tropidonophis mairii*)												N												
King Brown Snake (*Pseudechis australis*)																							O	
Long-nosed Water Dragon (*Lophognathus longirostris*)				P						P														
Marbled Velvet Gecko(*Oedura marmorata*)			F	F													N							
Metallic Snake-eyed Skink (*Cryptoblepharus metallicus*)			F																				O	

Species	Trapping transects						Camera transects					Wetland surveys			Nocturnal surveys						Diurnal		Incidental + other surveys	Acoustic survey
	A + Noct. 6	B	C	D + L + Noct. 6	E	F	G	H	I	J	K	GB + Noct. 3	RP 1	MC	1	2	5	7	8	9	1	2		
Northern Dtella (*Gehyra australis*)				F													N	N		N			O	
Northern Small-eyed Snake (*Cryptophis pallidiceps*)						F																		
Marbled Velvet Gecko (*Oedura marmorata*)				E																				
Port Essington Ctenotus (*Ctenotus essingtonii*)			3 x F	P																				
Saltwater Crocodile (*Crocodylus porosus*) MIGRATORY												N												
Slaty-grey Snake (*Stegonotus cucullatus*)												N												
Striped Rainbow Skink (*Carlia munda*)		2 x F																						
Swanson's Snake-eyed Skink (*Cryptoblepharus cygnatus*)			2 x F			2 x F															O			
Three-Spined Rainbow Skink (*Carlia triacantha*)			F																					
Two-Lined Dragon (*Diporiphora bilineata*)		F																					O	
Water Python (*Liasis mackloti*)												N												
Zig-zag Gecko (*Oedura rhombifer*)		F															N	N						

APPENDIX L: SUMMARY OF PREVIOUS FAUNA SURVEYS ON THE RPA

Survey	Survey type and date	Methods	Number of species recorded	EPBC and TPWC listed species recorded
ER A Birdwatch Events 2011	Field survey 2011	Opportunistic searches	58 birds	Rainbow Bee-eater (*Merops ornatus*) Common Sandpiper (*Actitis hypoleucos*) White-bellied Sea-eagle (*Haliaeetus leucogaster*)
Terrestrial vertebrate fauna and terrestrial flora surveys for REP Option 1 (Firth & Davey 2011)	Field survey May 2010	Systematic – Quadrats and transects (pit- traps, Elliott and cage traps), bird census, and diurnal opportunistic searches	4 amphibians 10 reptiles 45 birds 3 mammals 2 introduced	Partridge Pigeon (*Geophaps smithii smithii*) Rainbow Bee-eater (*Merops ornatus*)
Surveys for rock dwelling fauna at Ranger (Firth 2010b)	Field survey April 2010	Systematic – Transects with Elliott traps	One mammal	Common Rock-rat (*Zyzomys argurus*) (first record for the RPA)
Surveys for rock dwelling fauna at Ranger (Firth 2010b)	Field survey November 2009	Systematic – transects (Elliott traps)	One mammal	None
REP Biodiversity surveys, Part A Terrestrial vertebrate fauna and terrestrial flora (Firth 2010a)	Field survey wet/dry season 2009	Systematic – Quadrats and transects (pit- traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	12 frogs 27 reptiles 78 birds 11 mammals	Fawn Antechinus (*Antechinus bellus*) Partridge Pigeon (*Geophaps smithii smithii*) Merten's Water Monitor (*Varanus mertensi*)
ERA Birdwatch Events 2009	Field survey 2009	Opportunistic searches	75 birds	Common Greenshank (*Tringa nebularia*) Glossy Ibis (*Plegadis falcinellus*) Rainbow Bee-eater (*Merops ornatus*) White-bellied Sea-eagle (*Haliaeetus leucogaster*)

Survey	Survey type and date	Methods	Number of species recorded	EPBC and TPWC listed species recorded
ERA Birdwatch Events 2008	Field survey 2008	Opportunistic searches	72 birds	Cattle Egret (*Ardea ibis*) Common Sandpiper (*Actitis hypoleucos*)) Glossy Ibis (*Plegadis falcinellus*) Rainbow Bee-eater (Merops ornatus) White-bellied Sea-eagle (*Haliaeetus leucogaster*
Pre-clearance fauna survey of the future trial landform site (Firth 2008b)	Field survey April 2008	Systematic – Transects (Elliot's, pit-traps and cage traps), bird census, diurnal and nocturnal opportunistic searches	5 amphibians 9 reptiles 32 birds 5 mammals 2 introduced	Fawn Antechinus (*Antechinus bellus*) Partridge Pigeon (*Geophaps smithii smithii*)
Site inspection of the proposed extension to Jabiru Airstrip (Firth 2008c)	Field survey July 2007	Opportunistic site inspection	3 reptiles 19 birds 1 mammal	None
Agile Wallabies and irrigation water (Firth 2007)	Field survey September 2007	Systematic – Transects comparing irrigated MLAA areas and non- irrigated areas for Agile Wallaby numbers	N/A	None
Baseline Flora and Fauna Surveys in New Exploration Areas for 2007 (Smith 2009)	Field survey June 2007	Systematic – Quadrats and transects (pit- traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	1 amphibian 8 reptiles 57 birds 2 mammals 3 introduced	Partridge Pigeon (*Geophaps smithii smithii*) Rainbow Bee-eater (*Merops ornatus*)

Survey	Survey type and date	Methods	Number of species recorded	EPBC and TPWC listed species recorded
Baseline Flora and Fauna Surveys of New Land Application Are as in the Corridor Creek Area (Firth 2008a)	Field survey May 2007	Systematic – Quadrats (pit-traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	6 amphibians 18 reptiles 45 birds 5 mammals 3 introduced	Fawn Antechinus (*Antechinus bellus*) Merten's Water Monitor (*Varanus mertensi*) Partridge Pigeon (*Geophaps smithii smithii*) Rainbow Bee-eater (*Merops ornatus*)
ERA Birdwatch Events 2007	Field survey 2007	Opportunistic searches	71 birds	Cattle Egret (*Ardea ibis*) Common Sandpiper (*Actitis hypoleucos*) Glossy Ibis (*Plegadis falcinellus*) Partridge Pigeon (*Geophaps smithii smithii*) Rainbow Bee-eater (Merops ornatus) White-bellied Sea-eagle (*Haliaeetus leucogaster*)
Baseline Vegetation and Brush-tailed Rabbit-rat Survey for the New Land Application Areas: July/August 2006 (Brady et al. 2006)	Field survey July/August 2006	Systematic – Quadrats and transects (pit- traps, Elliott & cage traps), diurnal and nocturnal opportunistic searches	5 reptiles 61 birds 5 mammals 1 introduced	Fawn Antechinus (*Antechinus bellus*) Partridge Pigeon (*Geophaps smithii smithii*)
ERA Birdwatch Events 2004	Field survey 2004	Opportunistic searches	61 birds	Cattle Egret (*Ardea ibis*) Common Sandpiper (*Actitis hypoleucos*) Glossy Ibis (*Plegadis falcinellus*) White-bellied Sea-eagle (*Haliaeetus leucogaster*)
ERA Birdwatch Events 2006	Field survey 2006	Opportunistic searches	63 birds	Cattle Egret (*Ardea ibis*) Common Sandpiper (*Actitis hypoleucos*) Rainbow Bee-eater (Merops ornatus) White-bellied Sea-eagle (*Haliaeetus leucogaster*)

Survey	Survey type and date	Methods	Number of species recorded	EPBC and TPWC listed species recorded
Brush-tailed Rabbit-rat targeted survey (Firth 2003)	April 2003	Systematic – targeted survey using quadrats	1 mammal	None
ERA Birdwatch Events 2003	Field survey 2003	Opportunistic searches	68 birds	None
Aquatic Studies at Ranger Mine: Whole-ecosystem Monitoring– Round 2 (Corbett et al. 2004)	Field survey May/June 2001	Systematic - Transects, pit-traps, Elliott & cage traps, bird census, diurnal and nocturnal opportunistic searches and recordings of microbats using AnaBat II	9 amphibians 9 reptiles 73 birds 19 mammals 1 introduced	Northern Quoll (*Dasyurus hallucatus*) Cattle Egret (*Ardea ibis*) Eastern Great Egret (*Ardea modesta*)
ERA Birdwatch Events 2001	Field survey 2001	Opportunistic searches	41 birds	Rainbow Bee-eater (Merops ornatus) White-bellied Sea-eagle (*Haliaeetus leucogaster*)
Results of baseline survey s of Bat fauna of the Jabiluka and Ranger mining leases, Northern Territory (Richards 1998)	Field survey conducted Sep 1998 & Nov 1997	Systematic - Recordings of microbats using AnaBat II	17 mammals	None
Fauna at Ranger Mine waste rock dumps: Colonisation of experimental revegetation plots and persistence of populations (Corbett 1999)	Field surveys Nov 1996 - Oct 1998	Systematic - pit-traps, Elliott & cage traps, bird census, diurnal and nocturnal opportunistic searches	16 amphibians 16 reptile 41 birds 16 mammals	Northern Quoll (*Dasyurus hallucatus*)

Survey	Survey type and date	Methods	Number of species recorded	EPBC and TPWC listed species recorded
A whole-ecosystem approach to Environmental monitoring: Ranger mi ne case study (Corbett 2000)	Field survey 1994 – 1998 (Microbats Nov 1997 only)	Systematic – Quadrats and transects, pit-traps, Elliott and cage traps, bird census, diurnal and nocturnal opportunistic searches and recordings of microbats using AnaBat II	15 amphibians 35 reptiles 115 birds 16 mammals	Northern Quoll (*Dasyurus hallucatus*) Cattle Egret (*Ardea ibis*) Common Greenshank (Tringa nebularia) Common Sandpiper (*Actitis hypoleucos*) Curlew Sandpiper (*Calidris ferruginea*) Marsh Sandpiper (*Tringa stagnatilis*) Rainbow Bee-eater (*Merops ornatus*) White-bellied Sea-eagle (*Haliaeetus leucogaster*)
Environmental monitoring at Ranger Mine: A whole-ecosystem Approach (Corbett 2006)	Field survey 1994/95	Systematic – Quadrats (pit-traps, Elliott & cage traps), bird census, diurnal and nocturnal opportunistic searches	15 amphibians 33 reptiles 130 birds 12 mammals	None
Waterbird Richness and Abundance at Ranger Waterbodies 1994-97 (Corbett et al 1997)	Field survey Oct 94 – Dec 97	Systematic – bird census	48 birds (field) 15 birds (desktop)	Broad-billed Sandpiper (*Limicola falcinellus*) Cattle Black-tailed Godwit (*Limosa limosa*) Egret (*Ardea ibis*) Caspian Tern (*Hydroprogne caspia*) Common Sandpiper (*Actitis hypoleucos*) Common Greenshank (*Tringa nebularia*) Curlew Sandpiper (*Calidris ferruginea*) Eastern Great Egret (*Ardea modesta*) Glossy Ibis (*Plegadis falcinellus*) Greater Sand Plover (*Charadrius leschenaultii*) Grey-tailed Tattler (*Tringa brevipesl*) Lesser Sand Plover (*Charadrius mongolus*) Little Ringed Plover (*Charadrius dubius*) Long-toed Stint (*Calidris subminuta*) Marsh Sandpiper (*Tringa stagnatilis*) Plover (*Pluvialis squatarola*) Pacific Golden Plover (*Pluvialis fulva*) Ruddy Turnstone (*Arenaria interpres*)

Survey	Survey type and date	Methods	Number of species recorded	EPBC and TPWC listed species recorded
				Swinhoe's Snipe (*Gallinago megala*) Terek Sandpiper (*Xenus cinereus*) Whimbrel (*Numenius phaeopus*) White-winged Tern (*Chlidonias leucopterus*) Wood Sandpiper (*Tringa glareola*)
The role of ants in mine site restoration in the Kakadu region of Australia's Northern Territory, with particular reference to their use as bio-indicators (Anderson et al. 1998)	Field survey 1993/94	Systematic - transects, pit- traps, opportunistic collections	No vertebrates	N/A

APPENDIX M: THREATENED AND MIGRATORY SPECIES RECORDED BY FAUNA SURVEYS WITHIN THE RPA (ENV AUSTRALIA 2012)

Common name	EPBC status	TPWC status	This study	Firth & Davey 2011	ERA bird watch event 2011	Firth 2010a	ERA bird watch 2010	Smith 2009	ERA bird watch 2008	Firth 2008A	Firth 2008b	era bird watch 2007	ERA bird watch event 2006	Brady et al 2006	ERA bird watch 2004	Corbett et al 2004	ERA bird watch event 2001	Corbett 2000	Corbett 1999	Corbett et al 1997
Bird species																				
Caspian Tern *(Hydroprogne caspia*)	MI																			X
Cattle Egret *(Ardea ibis*)	MI		X						X			X	X		X	X		X		X
Common Greenshank (*Tringa nebularia*)	MI						X											X		X
Common Sandpiper (*Actitis hypoleucos*)	MI				X				X			X	X		X			X		X
Curlew Sandpiper (*Calidris ferruginea*)	MI																	X		X
Eastern Great Egret (*Ardea modesta*)	MI		X												X					X
Glossy Ibis (*Plegadis falcinellus*)	MI						X		X			X			X					X
Marsh Sandpiper (*Tringa stagnatilis*)	MI																	X		X
Pacific Golden Plover (*Pluvialis fulva*)	MI																			X
Partridge Pigeon (*Geophaps smithii smithii*)	VU	VU	X	X		X		X		X	X	X		X						
Rainbow Bee-eater (*Merops ornatus*)	MI		X	X	X		X	X	X	X		X	X				X	X		
Whimbrel (*Numenius phaeopus*)	MI																			X
White-bellied Sea-eagle (*Haliaeetus leucogaster*)	MI		X		X		X		X			X	X		X		X	X		
Mammal species																				
Fawn Antechinus (*Antechinus bellus*)		EN	X			X				X	X			X						
Northern Quoll (*Dasyurus hallucatus*)	EN	CR														X		X	X	
Reptile																				
Mertens' Water Monitor (*Varanus mertensi*)		VU				X				X										