



Flora and Fauna Report Dry Season, May 2013 Twin Bonanza Gold Project

Prepared by: EcOz Environmental Services

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EcOz Pty Ltd.
 ABN: 81 143 989 039
 Winlow House, 3rd Floor
 75 Woods Street
 DARWIN NT 0800
 GPO Box 381, Darwin NT 0800



Telephone: +61 8 8981 1100
 Facsimile: +61 8 8981 1102
 Email: ecoz@ecoz.com.au
 Internet: www.ecoz.com.au

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Executive Summary

ABM Resources NL (ABM) commissioned EcOz Environmental Services (EcOz) to undertake flora and fauna surveys in the early 2013 dry season for the Twin Bonanza Gold Project (MLA29822 and Section 19). This is the third comprehensive biological study associated with the Twin Bonanza project. The two previous surveys were conducted in the wet and dry seasons of 2012 (GHD 2012; EcOz 2012). All survey results have been included in this report to provide a comprehensive baseline dataset for the project area.

Survey Objective

The objective of these surveys was to determine species diversity, map the dominant vegetation communities, identify feral animals, identify weed infestations, and identify the presence (or likely presence) of threatened species. This survey established flora and fauna sites in areas that have not yet been surveyed within the project area.

Flora Summary

This survey identified a total of 102 flora species. The combined flora survey results for the project area generated a total of 180 species (GHD 2012, EcOz 2012; this survey), of which none were threatened under Northern Territory or Commonwealth legislation. The desktop assessment indicated that it was unlikely that threatened flora species would be supported within the project area.

Surveys identified two flora species endemic to the Tanami Desert (*Acacia abbreviata* and *A. minutifolia*) and two species are of regional significance due to their restricted ranges in the NT (*Dampiera candidans* and *Sclerolaena muelleri*).

Five vegetation types were described within the project area, including:

- Vegetation type 1: Low *Eucalyptus brevifolia* isolated trees ± mid high *Acacia lysiphloia* or low *A. hilliana* isolated shrubs over *Triodia basedowii* open hummock grassland. Occurs on rocky outcropping.
- Vegetation type 2: *Triodia basedowii* and *T. intermedia* mid open hummock grassland with *Acacia minutifolia* and *A. adoxa* var. *adoxo* low open shrubland. Occurs on gravel flat to gentle relief.
- Vegetation type 3: Open *Triodia* spp. hummock grassland ± low *Eucalyptus brevifolia* or *Hakea lorea* isolated trees with tall ± *Grevillea wickhamii* or *Acacia* spp. open shrubland. Occurs in sand plains.
- Vegetation type 4: Low *Corymbia opaca* or *Eucalyptus victrix* ± *Eucalyptus brevifolia* open woodland with tall *Acacia sericophylla* open shrubland over *Triodia pungens* open hummock grassland. Occurs in Palaeochannels.
- Vegetation type 5: *Acacia aneura* woodland over mixed tussock grass. Occurs within a variety of landform, however always present on heavy soils with high clay content.

No threatened ecological communities were identified by desktop review or on ground studies. The palaeodrainage channel was highlighted as a sensitive habitat type, as palaeochannels in the Tanami Desert are known to support a high level of biodiversity (including threatened species refuge).

Vegetation condition within the project area was described as largely intact native vegetation, with only minor impacts from fire and weeds.

Three weed infestations were located within the project area, which are all relatively small Buffel Grass infestations (*Cenchrus ciliaris*). Locations included Wilsons Camp, Wilsons Bore and the junction of Tanami Road/Wilsons Camp Access Track. As these infestations are relatively minor and localised, efforts to control and monitor these infestation should be implemented as soon as possible.

Fauna Summary

This survey identified a total of 70 fauna species, including 13 reptiles, 42 birds, and 15 mammals. The combined fauna survey results for the project area generated a total of 112 species, including 30 reptiles, 58 birds, and 24 mammals. No amphibians were found during the survey. Two of the species are threatened under Northern Territory and Commonwealth legislation and will require specific management measures to ensure that impact to individuals and populations is appropriately mitigated:

- Brush-tailed Mulgara (*Dasyercus blythi*) – Vulnerable under the TPWC Act
- Greater Bilby (*Macrotis lagotis*) – Vulnerable under the TPWC Act and EPBC Act.

The desktop assessment indicated that an additional threatened fauna species may be supported in habitat types within the project area (but were not identified during surveys) and should form part of the projects biodiversity management, these included:

- Great Desert Skink (*Liopholis kintorei*) – Vulnerable under the TPWC Act and EPBC Act

Crest-tailed Mulgara (*Dasyercus cristicauda*), which is listed as vulnerable under the TPWC Act and EPBC Act, was highlighted as potentially present by the EPBC protected matters search tool, however interrogation of distribution, ecology, and known records discounted this species as a potential to occur within the project area. Reasons for confusion associated with this species and *D. blythi* are due to a relatively recent species split. It is likely that the EPBC database does not separate these species at this stage.

Two introduced species, Feral Cat (*Felis catus*) and One-humped Camel (*Camelus dromedarius*), were recorded during the fauna survey. 'Predation by feral cats' is listed as a key threatening process under the EPBC Act. Cats have played a significant role in the decline of several species of native fauna in the arid zone, including the Greater Bilby. One-humped Camel is likely to cause localised impacts to vegetation and wetlands; however, they are unlikely to impact on threatened flora and fauna within the project area.

Recommendations

The following management plans should be prepared to properly address and manage biodiversity risks associated with the Twin Bonanza project:

- Greater Bilby Management Plan (species confirmed to be within disturbance area)
- Brush-tailed Mulgara Management Plan (species confirmed to be within disturbance area)
- Palaeochannel Vegetation Monitoring Program (Palaeochannels are noted as important habitat for biodiversity and cultural reasons)
- Weed Management Plan (standard in all developments, and three small infestations were observed within the project area)
- Pest Management Plan (focused on Feral Cats, as they were observed during surveys and are a known threatening process for Greater Bilby). It is important that operations within the Tanami increase cat and other predator populations as this will increase threat to threatened mammals. ABM may also choose to implement a cat control program in the local area to target cats in order to attempt to reduce predation threat on Greater Bilby.

We suggest that the above management plans are provided within a single document that is focused towards the management of biodiversity values of the project area (i.e. Biodiversity Management Plan).

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- Appendix A EPBC Act Report (online access – 28/11/2012)
- Appendix B Fauna Survey Results, May 2013
- Appendix C Bat Identification Report, May 2013
- Appendix D Existing Fauna Records for the Project Area and Surrounds (updated May 2013)
- Appendix E Flora Survey Results, May 2013
- Appendix F Site Description Summaries, May 2013
- Appendix G Existing Flora Records for the Project Area and Surrounds (updated May 2013)
- Appendix H Naturalised Weed Species List
- Appendix I Field Photographs May 2013

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Cover Images

A selection of images taken during the Twin Bonanza May 2013 flora and fauna surveys.

1 Introduction

ABM Resources NL (ABM) is a mineral exploration company that currently holds tenements covering 30,000 km² in the Tanami-Arunta and Central Australia regions.

ABM proposes to develop a gold mining operation within MLA29822. This project is called Twin Bonanza, which will include (at minimum) open pit mining (potentially followed by underground mining), onsite processing, tailings storage facility, waste rock dumps, bore field, wash-down facility, laydown pads, and ancillary infrastructure. The existing airstrip (which is currently operational) will require an extension in order for it to service larger aircraft.

In May 2013, EcOz Environmental Services (EcOz) was contracted by ABM to undertake a dry season flora and fauna survey of MLA29822 and Section 19, which forms the boundary of the Twin Bonanza Project Area (referred to in this report as the 'project area') (see Figure 1). MLA29822 includes all proposed mining infrastructure and resources and Section 19 includes areas where additional infrastructure is expected to occur outside MLA29822, including tracks, bores and the airstrip extension. This report presents information from this survey, and also summarises data collected from two previous biological surveys conducted within the project area in 2012.

1.1 Scope of Work

The objectives for the flora and fauna survey of MLA29822 and Section 19 were to:

- Describe and characterise the existing terrestrial vertebrate biodiversity within the project area for development that may be affected by disturbance.
- Describe and map vegetation communities.
- Describe threatened species that may potentially be impacted by the development.
- Describe and map weed infestations (if present).
- Provide preliminary recommendations towards potential targeted management measures in order to minimise environmental disturbance.

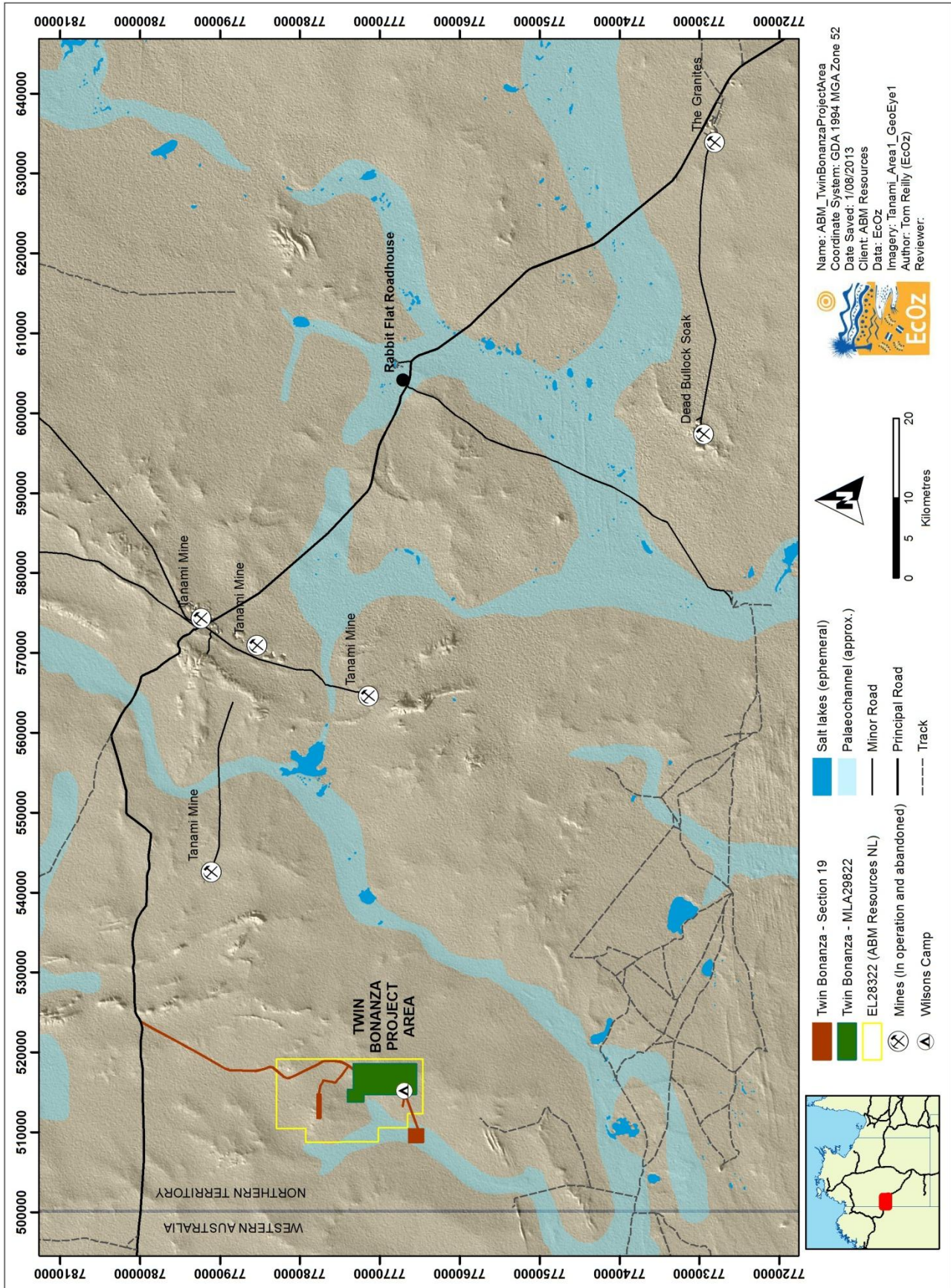


Figure 1. Twin Bonanza Project Area (includes MLA29822 and Section 19)

2 Legislation

The ABM proposal requires approval under the *Environmental Assessment Act* (Northern Territory) and *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (Commonwealth). As part of this process the Northern Territory and Commonwealth Governments will set conditions of approval relating to the management of potential environmental impacts of the proposal. These conditions will be included in permit, lease or license conditions and in relevant management procedures (e.g. Mining Management Plans and Environmental Management Plans) for the construction and operation of the project.

In addition the Northern Territory and Commonwealth legislation establishes statutory obligations for the protection of threatened flora and fauna. The implications of these Acts for the ABM proposal are briefly discussed below.

2.1 Territory Parks and Wildlife Conservation Act

The *Territory Parks and Wildlife Conservation Act* (TPWC) is administered by the Parks and Wildlife Commission and makes provision for and in relation to the establishment of Territory Parks and other Parks and Reserves and the study, protection, conservation and sustainable use of wildlife.

In the NT, wildlife may be either 'protected' or 'unprotected'. Under section 43 of the Act, protected wildlife is defined as all wildlife that occurs in a park, reserve, sanctuary, wilderness zone or area of essential habitat, or wildlife that is a vertebrate that is indigenous to Australia, or the Regulations may prescribe species of wildlife that are protected wildlife, or the Minister for Parks and Wildlife may declare that a species of wildlife is protected wildlife.

Protected wildlife also includes 'threatened wildlife'. Under section 30 of the Act, threatened wildlife includes those species for which their conservation status has been determined as either being Critically Endangered, Endangered or Vulnerable.

The removal of protected wildlife from the wild requires a 'Permit to Take' from the NT Government.

2.2 Environment Protection and Biodiversity Conservation Act

The Australian Government mechanism for national environment protection and biodiversity conservation is the *Environment Protection and Biodiversity Conservation Act 1999 Act* (EPBC). The EPBC Act provides for:

- Identification and listing of threatened species and threatened ecological communities
- Development of recovery plans for listed species and ecological communities
- Recognition of key threatening processes
- Reducing these processes through threat abatement plans (where appropriate)

The EPBC Act establishes lists of nationally threatened species and ecological communities which are Matters of National Environmental Significance protected by the Act.

3 Desktop Review

Prior to designing and conducting an on-ground survey, the most up-to-date understanding of the ecological context for the project area was established through collating information from previous studies and existing datasets. The data enquiry included broad scale reviews of available data pertaining to climate, geomorphology, land systems, land units, vegetation mapping, existing flora and fauna records, known distributions and preferred habitats for flora and fauna species, as well as the current status of disturbance in the region.

A review of flora and fauna which are recorded to occur or predicted to occur within the proposed disturbance areas was compiled from the following sources:

- Northern Territory Fauna Atlas (Department of Land Resource Management) (DLRM)
- Atlas of Living Australia (<http://www.ala.org.au>) (ALA)
- EPBC Protected Matters Search Tool (<http://www.environment.gov.au/epbc/pmst/index.html>)

3.1 Regional Environmental Setting

The Tanami Desert is known as “one of the most important biological areas in Australia particularly as it provides a refuge for several of Australia’s rare and endangered species” (Gibson 1986). Drawing on this theme, the area was highlighted in Morton et al (1995) as a refuge for biological diversity in arid and semi-arid Australia. This diversity was initially thought to be related to the presence of palaeodrainage habitat which supports richer vegetation than the surrounding area. However, a more recent study suggested that diversity is high throughout the Tanami, and species richness is probably determined more by local seasonal factors (Paltridge & Southgate 2001).

The project falls within the Tanami Bioregion (Figure 2) (Baker et al 2005). This bioregion covers all of ABM tenements of the Tanami project and has an area of approximately 258 224 km². The terrain is mostly flat red sand plains with minor dunes and exposed rock occurring at hills and low lying ranges. The dominant vegetation is hummock grassland with paths of open Eucalyptus forests on a grassy understory. The unique habitat of the Tanami Palaeodrainage System and the relative absence of exotic animals and plants make this area a refuge to a high concentration of threatened species (Harrison et al 2009).

Despite the arid climate, this bioregion is home to two nationally significant wetlands (all ephemeral): Lake Surprise (Yinapaka) and the Lake Gregory area. Additionally there are a range of smaller ephemeral wetlands over 20 km away. No permanent surface water is located in the region.

The majority of the bioregion appears in good condition with little major development, apart from cattle production and mining. Current threats to the bioregion are changed fire regimes and the introduction of exotic plants and animals.

Fourteen threatened species have been recorded in the region, including Greater Bilby (*Macrotis lagotis*), Brush-tailed Mulgara (*Dasycercus blythi*), and one historical record of the Night Parrot (*Pezoporus occidentalis*). This bioregion has experienced some of highest extinction rates for native mammals, with thirteen species now classified as extinct.

The project area falls outside of the South-west Tanami Site of Conservation Significance (SOCS) (Figure 2). Due to the Tanami Palaeodrainage System and the relative absence of exotic animals and plants, this area is known to have a high concentration of threatened species (Harrison et al 2009). This area is recognised as being a stronghold for the Greater Bilby (*Macrotis lagotis*), Brush-tailed Mulgara (*Dasycercus blythi*), Crest-tailed Mulgara (*Dasycercus cristicauda*) and Great Desert Skink (*Liopholis kintorei*) (Ward & Harrison 2009). It also supports several ephemeral wetlands and one plant species (*Marsilea latzii*) that is unique to the area.

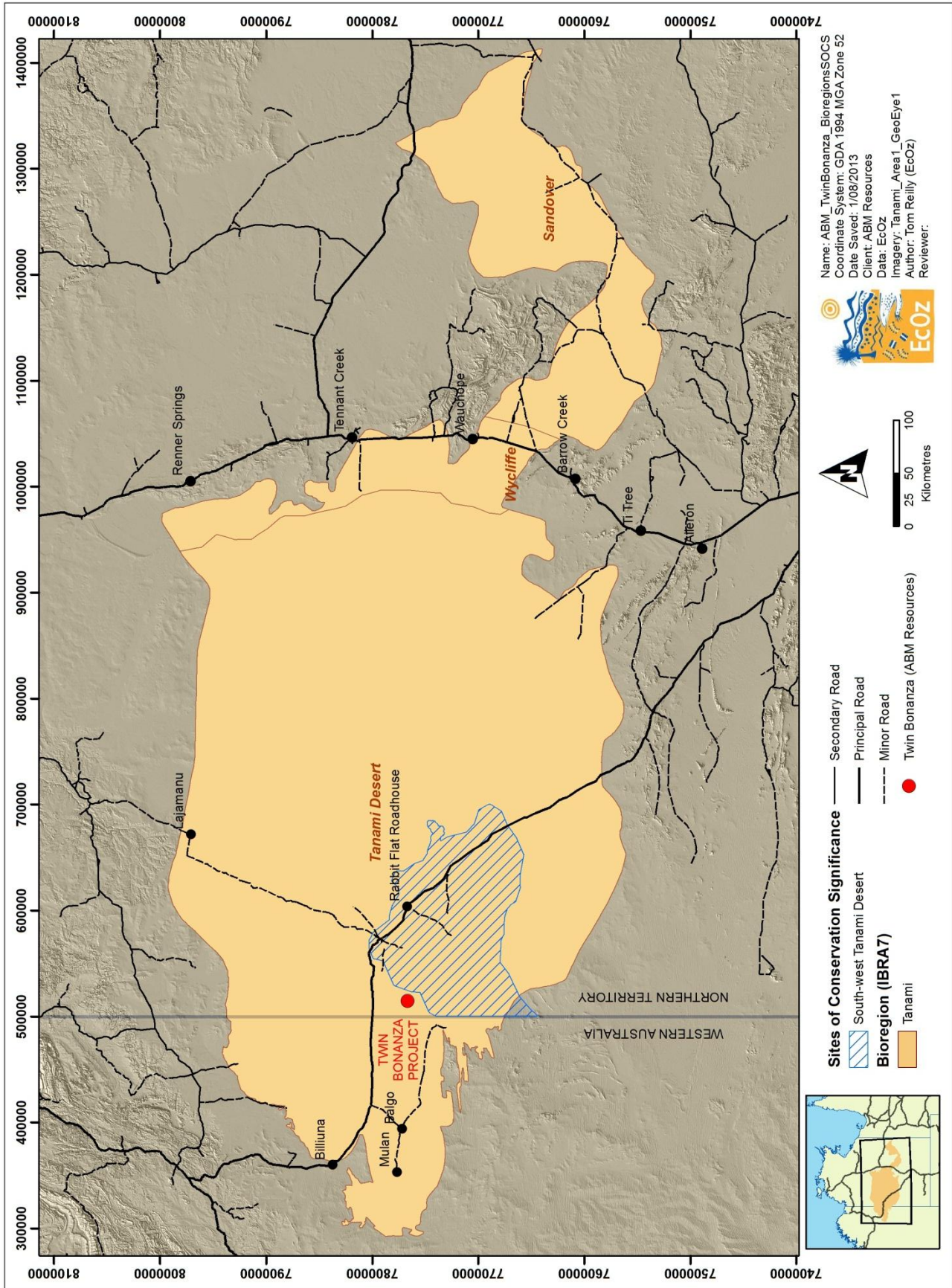


Figure 2. Bioregions and Sites of Conservation Significance in the vicinity of Twin Bonanza

3.2 Regional flora and fauna data

3.2.1 NT Atlas Records

A review of existing flora and fauna records for the Tanami bioregion highlighted that survey effort has been concentrated around mining projects (i.e. The Granites, Groundrush, and Tanami Mine), CLC projects, and road side records (see Figure 3 and Figure 4). Apart from the recent surveys for the Twin Bonanza Project (of which data has not yet been submitted to the DLRM), very little survey effort has occurred within 20 km of the Old Pirate project area. It should be noted that sometimes many records are allocated to a single coordinate, which skews interpretation of the point location maps.

NT fauna atlas records indicate that 404 fauna species have been identified in the Tanami Desert bioregion, including 12 amphibians, 106 reptiles, 224 birds, and 62 mammals. Of these, 14 are threatened and 11 are extinct under the *TPWC Act* and 17 are threatened or extinct under the *EPBC Act* (see Table 1). Nine are introduced species (discussed further in Section 3.5).

NT flora atlas records indicate that 1026 flora species have been identified in the Tanami Desert bioregion, covering a total of 96 families (species list is not provided in this report). Of these, one species is threatened under the *TPWC Act* and the *EPBC Act* (refer to Section 3.4 for discussion on threatened species). Records indicate that seven introduced species have been identified in the region, however, it is highly likely that many more introduced/exotic species occur and have not been included in the NT Atlas dataset.

3.2.1 Historic surveys within the project area and surrounds

Prior to the large scale biological surveys in the Tanami Desert by Gibson (1986), specific records were mostly non-existent due to the fact that most early explorers tended to skirt around the edge of the Tanami. In the 1960's, biological surveys were undertaken in an area previously known as the Tanami Desert Wildlife Sanctuary. Later surveys in the 1970's and 1980's were focussed on the study of rare and endangered wildlife in the area (Gibson 1986).

Several environmental studies commissioned by Normandy in the mid to late 1990s in the vicinity of Twin Bonanza (Preece 1995; EcOz 1995; EcOz 1996a; EcOz 1996b; EcOz 1996c; EcOz 1998; EcOz 1999). These studies were "Environmental Profiles" associated with various mining developments in the Tanami Desert (i.e. Wilsons camp and airstrip, Windy Hill, Tanami Mine, Dead Bullock Soak). Environmental profile descriptions contained brief vegetation summaries and fauna observations (and habitat), but did not include trapping, targeted species searches or vegetation mapping.

3.2.2 The Tanami Regional Biodiversity Monitoring Program

The Central Land Council (program manager) and various other mining companies within the Tanami Bioregion are also involved in the Tanami Regional Biodiversity Monitoring Program (RBM Program). This program surveys flora and fauna biodiversity across a selection of land form types in close proximity to the mining or exploration areas with the aim of monitoring possible impact on species biodiversity over time (and also to help increase species knowledge within the Tanami).

ABM has supplied funding towards this program and apparently sites have been established to cover the Twin Bonanza project area. However, site and species data has not yet been provided to ABM at the time of writing this report (*Pers Comm.* Justin Robins, ABM Resources Environment Manager, 2013).

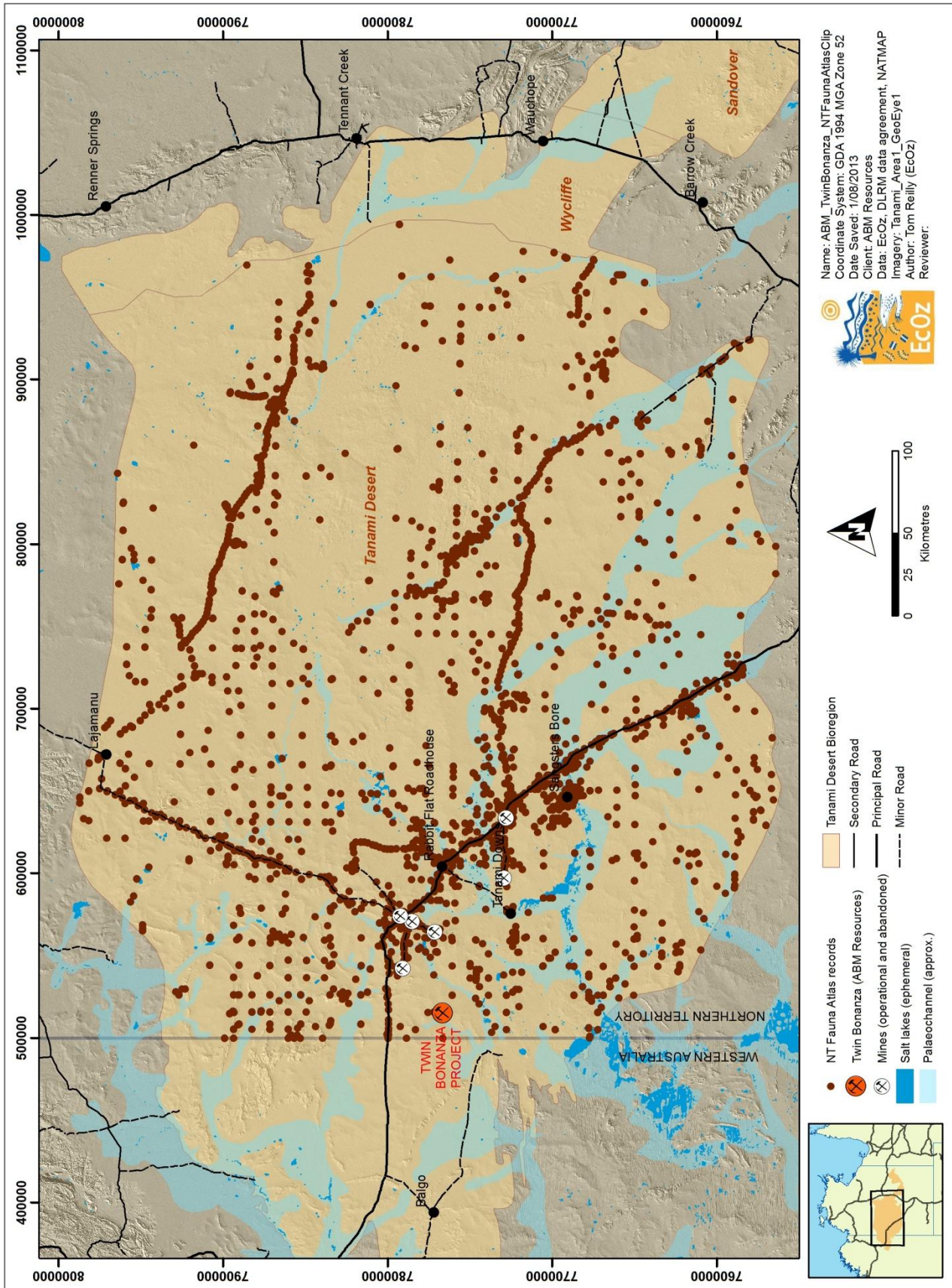


Figure 3: NT Atlas fauna records clipped to the Tanami Bioregion

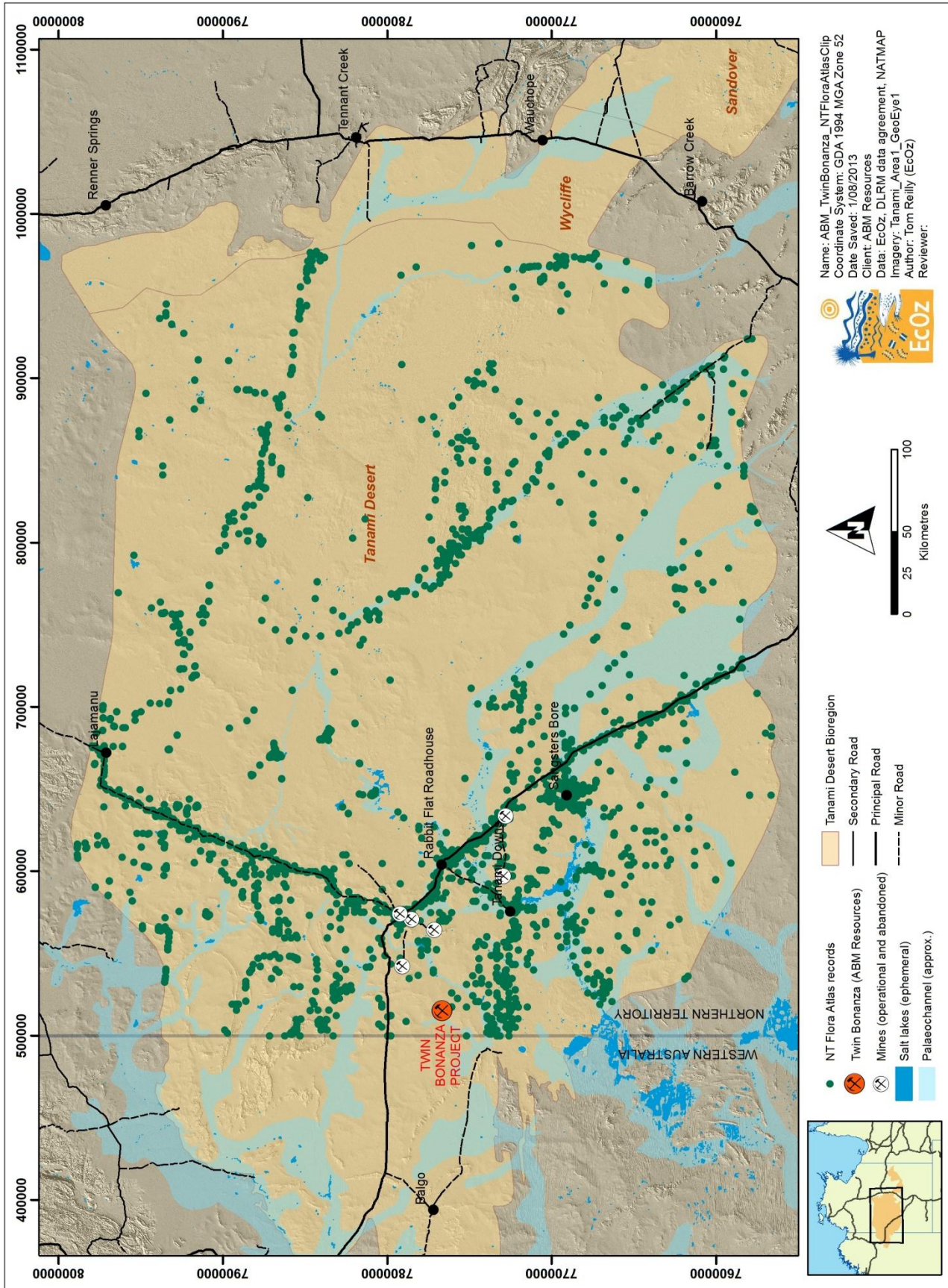


Figure 4: NT Atlas flora records clipped to the Tanami Bioregion

Table 1. Threatened Species Records for the Tanami Bioregion (from NT Atlas database).

Scientific Name	Common Name	Animal Group	Date Sighted	
			Pre 1970s	Post 1970s
FAUNA				
Extinct in the Wild				
<i>Lagorchestes hirsutus</i>	Mala	Mammal	21	51
Extinct				
<i>Bettongia penicillata</i>	Brush-tailed Bettong	Mammal	6	0
<i>Bettongia lesueur</i>	Burrowing Bettong	Mammal	4	0
<i>Lagorchestes asomatus</i>	Central Hare-wallaby	Mammal	6	0
<i>Onychogalea lunata</i>	Crescent Nailtail Wallaby	Mammal	5	0
<i>Perameles eremiana</i>	Desert Bandicoot	Mammal	7	0
<i>Macrotis leucura</i>	Lesser Bilby	Mammal	1	0
<i>Chaeropus ecaudatus</i>	Pig-footed Bandicoot	Mammal	1	0
<i>Phascogale calura</i>	Red-tailed Phascogale	Mammal	1	0
<i>Notomys amplus</i>	Short-tailed Hopping-mouse	Mammal	1	3
<i>Dasyurus geoffroii</i>	Western Quoll	Mammal	12	0
Critically Endangered				
<i>Leipoa ocellata</i>	Malleefowl	Bird	1	0
<i>Pezoporus occidentalis</i>	Night Parrot	Bird	0	2
Endangered				
<i>Zyzomys pedunculatus</i>	Central Rock-rat	Mammal	2	0
<i>Isoodon auratus</i>	Golden Bandicoot	Mammal	12	0
Vulnerable				
<i>Liopholis kintorei</i>	Great Desert Skink	Reptile	33	17
<i>Erythrura gouldiae</i>	Gouldian Finch	Bird	0	2
<i>Tyto novaehollandiae kimberli</i>	Masked Owl (mainland)	Bird	0	1
<i>Polytelis alexandrae</i>	Princess Parrot	Bird	1	1
<i>Erythrotriorchis radiatus</i>	Red Goshawk	Bird	0	1
<i>Rostratula australis</i>	Australian Painted Snipe	Bird	0	4
<i>Macrotis lagotis</i>	Bilby	Mammal	26	501
<i>Dasyercus blythi</i>	Brush-tailed Mulgara	Mammal	10	220
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Mammal	10	15
<i>Notoryctes typhlops</i>	Southern Marsupial Mole	Mammal	0	16
Near Threatened				
<i>Petrogale lateralis</i>	Black-footed Rock-wallaby ^{EPBC}	Mammal	3	12
FLORA				
Vulnerable				
<i>Eleocharis papillosa</i>	Dwarf Desert Spike-rush	Plant	0	4

3.3 Project area flora and fauna data

3.3.1 Old Pirate Flora and Fauna Surveys – Wet Season 2012

ABM commissioned baseline flora and fauna surveys of the Old Pirate deposit in April 2012 (GHD 2012). Old Pirate is one of the key deposits associated with the Twin Bonanza Project.

Three distinct vegetation types were identified in the study area, including.

- Rocky outcropping

Mid open *Triodia intermedia* and *T. schinzii* hummock grassland with *Eucalyptus brevifolia* low open woodland with low sparse *Acacia acradenia*, *Senna sericea* and *A. sp.* Urandangi shrubland.

- Gravelly Spinifex Grassland with Acacia Shrubland

Triodia basedowii and *T. intermedia* mid open hummock grassland with *Acacia minutifolia* and *A. adoxa var. adoxa* low open shrubland.

- Grassland with Sparse Woodland

Northern subtype – *Aristida holathera*, *Triodia schinzii* and *T. intermedia* low open tussock/hummock grassland with *Corymbia candida* low open woodland.

Southern subtype – Mid open *Triodia basedowii* hummock grassland with *Eucalyptus brevifolia* low open woodland with mid sparse *Acacia lysiphloia* shrubland.

A total of 131 flora species were identified during vegetation mapping surveys. Two flora species (*Acacia abbreviata* and *A. minutifolia*) endemic to the Tanami Desert were recorded and two species are of regional significance due to their restricted ranges in the NT (*Dampiera candidans* and *Sclerolaena muelleri*). No threatened flora species of legislative significance were identified during the survey.

A total of 93 fauna species were detected, consisting of 24 reptiles, 49 birds and 20 mammals. Two introduced species, Feral Cat (*Felis catus*) and One-humped Camel (*Camelus dromedaries*), were recorded within the study area. Two threatened fauna species were found to be present at the site, including:

- Brush-tailed Mulgara (*Dasymercus blythi*) – Vulnerable under the TPWC Act
- Greater Bilby (*Macrotis lagotis*) – Vulnerable under the TPWC Act and EPBC Act.

Species data for this survey is present in Appendix G.

3.3.2 Old Pirate Fauna Surveys – Dry Season 2012

ABM commissioned dry season fauna surveys in September 2012 within the Old Pirate prospect to ensure seasonal variation in fauna species was captured (EcOz 2012). A total of 57 fauna species were recorded during this survey comprising of 20 reptiles, 27 birds and 10 mammals, which included additional species to the previous wet season survey (see Appendix D). Two threatened species were recorded during the survey:

- Brush-tailed Mulgara (*Dasymercus blythi*) – Vulnerable under the TPWC Act
- Greater Bilby (*Macrotis lagotis*) – Vulnerable under the TPWC Act and EPBC Act.

At the time of the survey Australian Bustard (*Ardeotis australis*) was listed as Vulnerable under the TPWC Act. In late 2012 the DLRM threatened species review this updated its status to Near Threatened, which is of no legislative consequence.

Species data for this survey is present in Appendix D.

3.4 Threatened Species Likelihood of Occurrence Assessment

3.4.1 Threatened Species Categories

The International Union for the Conservation of Nature (IUCN) nominates a set of criteria used to identify species at risk to extinction used to define categories of risk (Figure 5). These criteria and categories are used by both the NT Government to identify threatened species and habitat which are listed under the *Territory Parks and Wildlife Conservation Act* (TPWC) and the Commonwealth Government to identify national threatened species under the *Environment Protection and Biodiversity Conservation Act* (EPBC). The focus of this report is flora and fauna species that are listed as threatened under either the TPWC Act or the EPBC Act (or both).

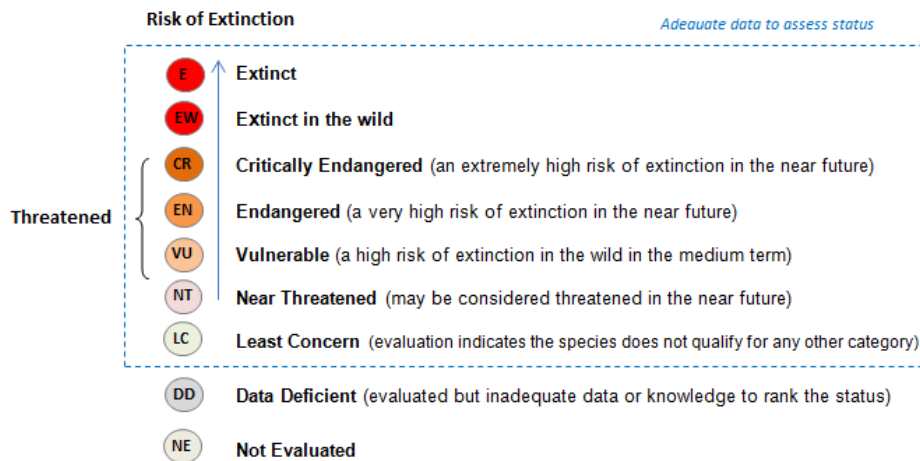


Figure 5. The IUCN red list categories of risk for threatened species

(Source: http://www.eoearth.org/article/IUCN_Red_List_Categories_and_Criteria)

3.4.2 Likelihood of Occurrence Criteria

Likelihood of occurrence was determined based on the criteria listed below which are based on a combination of available records and ecological knowledge of the area. These likelihood categories are also used by the EPBC Act and have therefore been adopted in attempt to make similar comparisons to those listings.

- **Likely or Known** – These species are listed if suitable habitat and records exist near the area (or are known to exist in the project area – i.e. point data exists).
- **May** – These species are listed if suitable habitat and records for the bioregions exist.
- **Unlikely** – These species are listed if no suitable habitat was present, are unknown from the area, or are locally extinct.

3.4.3 Threatened species likelihood of occurrence assessment

Twenty species were identified by EPBC protected matters search tool report (Appendix A) and DLRM databases as possibly occurring in the Twin Bonanza Project Area. A review of these species (Table 2) identified that:

- Two species are **likely or known** to occur in the project area.
 - Brush-tailed Mulgara (*Dasyercus blythi*)
 - Greater Bilby (*Macrotis lagotis*)
- One **may** occur in the project area.
 - Great Desert Skink (*Liopholis kintorei*)
- Eight are **unlikely** to occur in the project area.
 - Crest-tailed Mulgara (*Dasyercus cristicauda*)
 - Golden Bandicoot (*Isodon auratus*)
 - Black-footed Rock Wallaby (*Petrogale lateralis*)
 - Princess Parrot (*Polytelis alexandrae*)
 - Australian Painted Snipe (*Rostratula australis*)
 - Floodplain Monitor (*Varanus panoptes*)
 - Southern Marsupial Mole (*Notoryctes typhlops*)
 - Central Rock-rat (*Zyomys pedunculatus*)
- Nine species are **extinct** (some only extinct in the Northern Territory)
 - Burrowing Bettong (inland) (*Bettongia lesueri graii*)
 - Brush-tailed Bettong (*Bettongia penicillata*)
 - Pig-footed Bandicoot (*Chaeropus ecaudatus*)
 - Western Quoll (*Dasyurus geoffroii*)
 - Mala (*Lagorchestes hirsutus*)
 - Lesser Bilby (*Macrotis leucura*)
 - Crescent Nail-tailed Wallaby (*Onychogalea lunata*)
 - Desert Bandicoot (*Perameles eremiana*)
 - Red-tailed Phascogale (*Phascogale calura*)

Extinct species are omitted from the likelihood of occurrence assessment as these species will not form part of the management implications for the Twin Bonanza Project.

Table 2. Threatened species likelihood of occurrence assessment for the Twin Bonanza Project

Refer to Figure 5 for status key.

Threatened Species	Status		Habitat, Distribution, and Threats	Likelihood of occurrence
	EPBC	TPWC		
REPTILES				
Great Desert Skink <i>Liopholis kintorei</i>	VU	VU	Habitat: This species occurs in hummock grassland and specifically in the Tanami desert it occupies palaeodrainage lines (Pavey 2006f). Distribution: This species occurs in the western deserts of the Northern Territory and South Australia and parts of the Gibson and Great Sandy Desert in Western Australia (Pavey 2006f). Threats: At the present time their does not appear to be a single factor associated with the decline of this species. Potential threats could include habitat destruction, predation from feral animals, changed fire regimes (Pavey 2006f).	MAY Suitable habitat occurs within the project area. Records of the species occur in the northern Tanami desert. No records close to project area despite intensive survey effort.
Floodplain Monitor <i>Varanus panoptes</i>	-	VU	Habitat: Broad range of habitats from riparian to savannah woodlands (Christian 2004). Distribution: This species is found across northern Australia with a disjunct population in Western Australia (Christian 2004). Threats: This species experiences significant declines due to cane toad poisoning (Doody et al. 2009).	UNLIKELY Lack of suitable habitat within the project area and limited records within the northern Tanami Desert. Outside of currently known range.
BIRDS				
Princess Parrot <i>Polytelis alexandrae</i>	VU	VU	Habitat: This species occurs in the swales between sand dunes with a shrub layer of vegetation and scattered trees (Pavey 2006a) Distribution: In the Northern Territory this species if found in the southern section of the Tanami Desert. It also occurs patchily throughout the arid interior of Australia (Pavey 2006a). Threats: At the present time there is no known cause in the decline of this species. It is proposed that introduced herbivores and changes in the fire regime are probably causes in the decline (Pavey 2006a).	UNLIKELY Lack of suitable habitat within the project area and limited records within the northern Tanami Desert.
Australian Painted Snipe <i>Rostratula australis</i>	VU	VU	Habitat: Nomadic. Inhabits fringes of permanent and temporary wetlands, swamps and inundated grasslands (Taylor <i>et al.</i> 2006). Distribution: This species is scattered across Australia with no predictable occurrence (Rogers 2001). In the Northern Territory it is known from a range of localities with no known resident sites (Taylor <i>et al.</i> 2006). Threats: The main threat to this species is the loss of wetlands from degradation by cattle; however within the Northern Territory there is no substantial data to assess this (Jaensch 2003).	UNLIKELY Lack of suitable habitat within the project area and limited records within the northern Tanami Desert.

Threatened Species	Status		Habitat, Distribution, and Threats	Likelihood of occurrence
	EPBC	TPWC		
MAMMALS				
Black-footed Rock Wallaby <i>Petrogale lateralis</i>	VU	NT	Habitat: Occurs in upland rocky areas with associated steep slopes (Pavey 2006d). Distribution: In the Northern Territory this species is mostly found in the MacDonnell Ranges, but also occurs throughout the arid southern end of the Northern Territory (Pavey 2006d). Threats: The decline in this species is known to be associated with predation from introduced carnivorous mammals. Additionally the degradation of habitats by introduced herbivorous mammals is also a factor (Pavey 2006d).	UNLIKELY Lack of suitable habitat within the project area and limited records within the northern Tanami Desert.
Brush-tailed Mulgara <i>Dasyercus blythi</i>	-	VU	Habitat: This species has been found in a wide array of arid habitats but is more likely to be encountered in mature hummock grassland of Spinifex (Pavey et al. 2006a). Distribution: Due to considerable taxonomic confusion the exact distribution of this species and <i>D. cristicauda</i> is not well known in the Northern Territory (Pavey et al. 2006a) Confirmed records include the Simpson and Tanami Deserts with Threats: At the present time it is unknown what factors are causing a decline in this species. It is likely that habitat degradation caused by a change in fire regimes and the introductions of herbivorous mammals are likely causes (Pavey et al. 2006a).	KNOWN The species has been recorded in the project area during two previous surveys (GHD, 2012; EcOz, 2012).
Crest-tailed Mulgara <i>Dasyercus cristicauda</i>	EN	VU	Habitat: This species is known to prefer sand dune habitats that are vegetated with canegrass and spinifex (Masters, 1997). Distribution: Due to considerable taxonomic confusion the exact distribution of this species and <i>D. blythi</i> is not well known in the Northern Territory. The majority of the records are from the Simpson Desert with confirmed historical records from Charlotte Waters and Crown Point in the Northern Territory (Pavey et al. 2006b). Threats: At the present time it is unknown what factors are causing a decline in this species. It is likely that habitat degradation caused by a change in fire regimes and the introductions of herbivorous mammals are likely causes (Pavey et al. 2006b).	UNLIKELY The species was not recorded during two previous surveys in the project area (GHD, 2012; EcOz, 2012). No recent records close to project area.
Greater Bilby <i>Macrotis lagotis</i>	VU	VU	Habitat: This species is found in hummock grasslands on sandy soils with a preference for drainage lines (Southgate, 1990). Distribution: Historically this species was widespread in arid Australia. Currently in the Northern Territory it is most abundant in the Tanami Desert (Pavey, 2006b). Threats: The decline in this species is thought to be attributed to predation by introduced carnivorous mammals, competition with introduced herbivorous mammals and changed fire regimes (Southgate, 1987; Southgate & Carthew, 2006; Pavey 2006b).	KNOWN The species has been recorded in the project area during two previous surveys (GHD 2012; EcOz 2012).

Threatened Species	Status		Habitat, Distribution, and Threats	Likelihood of occurrence
	EPBC	TPWC		
Golden Bandicoot <i>Isoodon auratus</i>	VU	EN	<p>Habitat: Historically this species occupied desert country in a range of habitats. On Marchinbar Island it is associated with heath and shrub land (Southgate <i>et al.</i> 1996).</p> <p>Distribution: This species was once widespread across the Northern Territory, but is now known from Marchinbar Island (Palmer & Woinarski 2006).</p> <p>Threats: At the present time no single factor is known to have caused the decline in this species. The decline in this species is thought to be predation by introduced carnivorous mammals. Changed fire regimes may also affect this species (Palmer & Woinarski 2006).</p>	<p>UNLIKELY</p> <p>Lack of recent (pre 1971) records in the northern Tanami desert. The species is known from one location in the Northern Territory (Marchinbar Island off north-eastern Arnhem land)</p>
Southern Marsupial Mole <i>Notoryctes typhlops</i>	EN	VU	<p>Habitat: This species is found in sandy deserts where it is mostly associated with dunes, sandy plains and river flats (Pavey, 2006c).</p> <p>Distribution: This species occurs in central Western Australia, northern South Australia and southern Northern Territory. Within the Northern Territory it has been found as far north as Barrow Creek and appears to not appear in the Simpson Desert (Pavey 2006c).</p> <p>Threats: Due to its secretive nature and apparent decline this species may not be that uncommon as some recent surveys have found the species to be common in some areas. Proposed threats to this species include predation by introduced mammalian carnivores, soil compaction, and changes to overall food abundance due to changed fire regimes and grazing (Pavey 2006c).</p>	<p>UNLIKELY</p> <p>The northern Tanami desert represents the northern limit of the species distribution. Core habitat for this species does not occur within the project area.</p>
Central Rock-rat <i>Zyzomys pedunculatus</i>	EN	EN	<p>Habitat: This species is known to inhabit a range of grasslands and woodlands in the MacDonnell Ranges (Pavey 2007e)</p> <p>Distribution: Historically this species was once widespread in the arid regions of the Northern Territory and Western Australia (Baynes & Johnson 1996). Currently it has been rediscovered in the MacDonnell Ranges at a few sites (Pavey 2007e).</p> <p>Threats: At the present time no single factor is known to have caused the decline in this species (Cole 2000). The decline in this species is thought to be predation by introduced carnivorous mammals. Changed fire regimes may also affect this species (Pavey 2007e).</p>	<p>UNLIKELY</p> <p>Lack of suitable habitat within the project area and limited recent records within the northern Tanami Desert.</p>

3.5 Introduced Species

3.5.1 Existing pest data

A large range of introduced species have been previously recorded from this bioregion (Baker et al 2005). Of the species listed (Table 3) Feral Cat (*Felis catus*) and One-humped Camel (*Camelus dromedaries*) are the most abundant in the bioregion. Hard hoofed species (camels, donkeys and horses) create widespread erosion, damage native vegetation, introduce weeds and foul waterways. Exotic predators such as feral cats and foxes are efficient hunters that prey on a number of native species, particularly small to medium sized mammals. Environmental impacts from Feral Cat, European Rabbit (*Oryctolagus cuniculus*) and European Red Fox (*Vulpes vulpes*) are listed as Key Threatening Process under the EPBC act.

Table 3. Introduced fauna species known to occur in the Tanami Desert.

Introduced Fauna	Regional Status	Recorded Impacts
Dog <i>Canis lupus</i>	Widespread	Known to prey on many native species (Corbett 2007)
One-humped Camel <i>Camelus dromedaries</i>	Widespread	Known to cause an impact to native vegetation (Dorges & Heucke 2007).
Feral Donkey <i>Equus asinus</i>	Uncommon	Known to cause extensive erosion (Choquenot 2007).
Feral Horse <i>Equus caballus</i>	Uncommon	Known to damage native plants and the shelters of native animals (Berman 2007).
Feral Cat <i>Felis catus</i>	Widespread	Known to prey on many species on native animals (Denny 2007). Key threatening process under the EPBC Act.
House Mouse <i>Mus musculus</i>	Widespread	Vector for some diseases (Singleton 2007) but there does not appear to be any documented threats to biodiversity from this species
European Rabbit <i>Oryctolagus cuniculus</i>	Uncommon	Known to cause excessive damage to native plants (Williams & Myers 2007).
European Red Fox <i>Vulpes vulpes</i>	Present	Known to prey upon a range of native species (Catling & Coman 2007). Key threatening process under the EPBC Act.

3.5.2 Existing weed data

NT Atlas records for the Tanami bioregion indicate that 6 declared weed species occur in the region, which include one Weed of National Significance (WONS) (Table 4). The declared weeds are all listed as “B Class” under the Northern Territory Weeds Management Act, which means that growth and spread for these species are to be controlled.

There are 46 naturalised weed species (Appendix H). Naturalised weeds are species that have colonised ecosystems in which they did not previously exist, or they are exotic plants introduced into Australia that have formed naturalised populations.

Species listed as WONS mean that they have been identified by the Australian government as invasive and have the potential to cause infestations that may lead to environmental, social and economic impacts. Land Owners and Land Managers are responsible for managing WONS, and the governments are responsible for overall legislation and administration.

Table 4. NT Atlas weed records for the Tanami Bioregion.

Family	Scientific Name	Common Name	Listing Classification
FABACEAE	<i>Parkinsonia aculeata</i>	Parkinsonia	B Class; WONS
FABACEAE	<i>Senna obtusifolia</i>	Sicklepod	B Class
LAMIACEAE	<i>Hyptis suaveolens</i>	Hyptis	B Class
MALVACEAE	<i>Sida acuta</i>	Sida	B Class
POACEAE	<i>Cenchrus echinatus</i>	Mossman Grass	B Class
ZYGOPHYLLACEAE	<i>Tribulus terrestris</i>	Bindii	B Class

4 Methodology

4.1 Survey Timing and Personnel

The 2013 flora fauna surveys included two sequential three night surveys, the first being between May 10 and May 12 and the second between May 13 and May 15. Fauna, flora, weed, and vegetation surveys all ran concurrently to ensure that information was collected in a timely manner.

The survey team included four ecologists from EcOz:

- Tom Reilly – project leader and ecologist with several years' experience in the Tanami Desert.
- David van den Hoek – botanist from Tennant Creek with several years' experience in the NT.
- Brendan Schembri – zoologist who has conducted numerous trapping surveys in northern Australia (NT, Queensland and Western Australia) and specialises in herpetology.
- Will Riddell – zoologist with several years' experience in the NT, specialising in ornithology.

4.2 Land Unit Descriptions

Existing land unit mapping was ground truthed as part of the vegetation and habitat surveys. This exercise was conducted across the project area as a way of defining extent of preferred habitat types for threatened species and sensitive habitat.

4.3 Vegetation Survey

All levels of vegetation mapping and habitat characterisations followed the Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping (Brocklehurst et al 2007), with some minor modifications to suit the project scope and desert landscape. All methods are detailed below.

4.3.1 Site Selection

Vegetation survey sites were established within each vegetation type represented within the project area. These were established away from any ecotones to ensure we obtained a true description of the target community. In most circumstances, these sites were within the fauna sites, however there were some additional flora sites required in order to properly cover all major vegetation communities within the MLA and Section 19.

A total of 16 full vegetation survey sites and 7 vegetation checks sites were located and assessed within the survey area (see Figure 6). Full vegetation reference sites were labelled with the prefix VS followed by a unique number. Vegetation check sites were labelled with the prefix CS.

Vegetation survey sites were selected to both define the local habitat and contribute to vegetation mapping data for the study area. As some vegetation mapping has already been completed for part of the project area (GHD 2012) – our sites were chosen to complement that dataset. Current vegetation descriptions were used where appropriate, however some amendments were necessary.

Prior to the field survey, boundaries of vegetation types were visually defined from high resolution aerial imagery (GeoEye 2 m resolution) and mapping linework in ArcGIS10. The resultant polygons were then allocated "proposed vegetation types" which were subsequently ground-truth in the field (methods described below). The target scale of vegetation mapping was 1:30K.

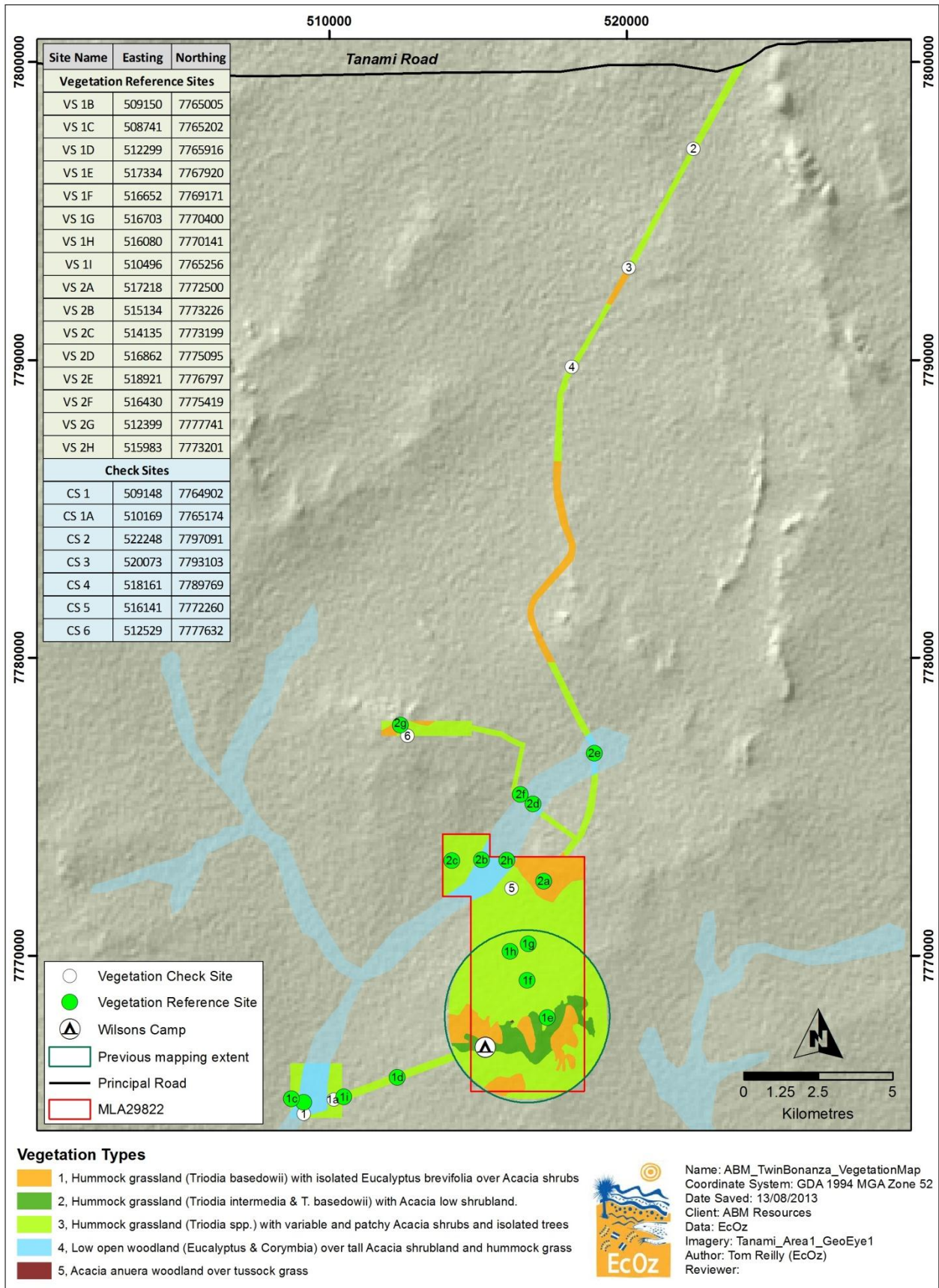


Figure 6. Flora Survey Sites – May 2013 – Twin Bonanza Project

4.3.2 Vegetation Reference Site

Vegetation reference sites are used for vegetation mapping and habitat characterisation. A comprehensive dataset is collected for each reference site. Reference sites are approximately 20 m by 20 m, and the following attributes are recorded:

- Site location: Global Positioning System (GPS) coordinates and general description.
- Habitat information: Landform pattern and element, vegetation patch size, aspect, slope, surface soil type (broad category only), estimated soil depth, estimated drainage capacity and percentage ground cover for standing biomass, litter, bare earth and pebble/rock/outcrop, presence of fallen logs, mistletoe, flowering plants and termite mounds (and their type).
- Status of disturbance: The time since the last fire and scorch height as well as the presence and extent (estimated cover) of weed species and the presence and stability of erosion.
- Broad structural information: The estimated crown separation ratio, the estimated percentage canopy cover or ground cover for the main three vegetation strata and their height range and average height.
- Floristic and structural Formation: For vegetation mapping a full list of species present is compiled along with canopy heights and percentage cover for each species in the strata.
- Basal sweep: Estimates of basal area for over-storey species using a basal wedge (for both live and dead trees) to give an estimate of species dominance.
- Habitat photos: Landscape digital photos taken in a north, south, east and west direction from the centre of the survey site.

For habitat characterisation and ground-truthing of vegetation types/communities the level of data collection aligns with methodologies described in Brocklehurst et al (2007). The above attributes were applied with some exceptions: for the floristic component only the dominant species (i.e. those contributing greater than 5% cover) and their associated cover and height are recorded, and the basal sweep component is omitted. Habitat characterisation comments are added to the floristic component to indicate which species are flowering or fruiting.

The methods of gathering data against the key attributes align with those recommended in Brocklehurst et al (2007), however some minor modifications were applied. These modifications include: estimating tree heights rather than measuring with a clinometer, and simplified observations and categories for soil characteristics and depth.

As recommended by the Northern Territory Guidelines (Brocklehurst et al 2007), estimates for canopy percentage cover is based on the crown being treated as opaque for the upper storey. This approach accommodates for seasonal deciduousness. Percentage cover estimates for the mid and ground strata are assessed using the percentage foliage cover (the percentage of the sample site occupied by vertical projection of foliage and branches).

Landform observations follow Speight (2009) in the Australian Soil and Land Survey Field Handbook.

Incidental records for weeds and fire were noted in all of survey areas and their surrounds and particular attention was paid to existing road corridors.

4.3.3 Vegetation Check Site

Vegetation check sites were undertaken in locations outside of fauna survey sites to more accurately attribute vegetation descriptions to vegetation mapping across the entire study area. Data collected for check sites is not as comprehensive as the reference sites described above. Attributes collected for check sites is as follows:

- Site location: Global Positioning System (GPS) coordinates and general description.
- Status of disturbance: The time since the last fire and scorch height as well as the presence and extent (estimated cover) of weed species and the presence and stability of erosion.
- Broad structural information: The estimated percentage canopy cover or ground cover for the main three vegetation strata and their height range and average height.
- Floristic and structural Formation: Canopy heights and percentage cover for the dominant species in the strata.
- Habitat photos: Landscape digital photos taken in a north, south, east and west direction from the centre of the survey site.

4.3.4 Species Identification

Flora species were identified where possible in the field with reference to Moore (2005) and Purdie et.al. (2008). If the identification of a species could not be confirmed in the field, a voucher specimen was collected for further inspection at the Northern Territory Herbarium. A number of specimens were identified at the Darwin Herbarium with the remainder identified at the Alice Springs Herbarium (with the aid of specialists in Low Ecological Services).

4.4 Fauna Survey

Fauna survey methods followed the *Northern Territory survey methods for flora and fauna surveys used for standard biodiversity unit survey sites* (NRETAS 2008). EcOz also maintains regular communications with NTG specialists to ensure that our survey method is consistent and up-to-date with other research and surveys in the Northern Territory. Applying standard approaches allows for explicit assumptions about the likely diversity present in similar habitats which have not being surveyed, and allows some comparison with surveys conducted in different locations which have also been assessed using the same standard.

4.4.1 Permits

EcOz has current animal ethics and NT parks and wildlife permits, details are as follows:

- Animal Ethics Project: A12005 "*Fauna Studies in the Northern Territory*". Expires 12/04/2014.
- Permit to Interfere with Protected Wildlife NT: 43782. Expires 31/03/2014.

EcOz are required to submit entire species datasets to NTG for inclusion in the NT Flora and Fauna Atlas. A report on species captured, methods, deaths, and lessons learnt is required under the ethics approval.

EcOz staff also obtained CLC permit to allow lawful access to aboriginal land for the survey period (permit number 15498).

4.4.2 Site Selection

The survey included 16 survey sites within the project area (Figure 7). Site selection aimed to represent the variation in habitat and vegetation types within the proposed development zones of the MLA29822 and Section 19, such as the proposed open cut pits, waste rock dumps, infrastructure area, access roads, airstrip expansion area, and camp.

4.4.3 Fauna Trap Layout

The layout of traps at each survey quadrat is based on the standard and accepted NT fauna survey guidelines for the southern bioregions of the N.T. (NREATS 2008). This involved laying traps within a transect based quadrat that measured approximately 30 m x 100 m. Trap number and layout is as follows:

- Twenty Elliott traps. Setup in two 100 m transects of 10 Elliott traps, with a trap spacing of 10 m.
- Four pitfall traps with 10 m of drift fence located between the two Elliott transects.
- Eight funnel traps set along pitfall drift fences.

Pitfall traps were 20 L white plastic buckets which were dug to ground level and set with 10 m of drift-fence. Where possible, the pits were located across different microhabitats within the quadrat. Funnel traps were set along the drift fence. Silver reflective thermafoil were set over pits and funnel traps to protect animals from dehydration and predation from raptors. Pits entrances were sprayed with Coopex to protect captured animals from ant kill/disturbance. The pits and funnels were opened for the duration of the survey (three nights and three days) and were checked early each morning and mid-afternoon.

The Elliott traps were baited each afternoon, opened overnight and closed for the duration of the day. Trapping occurred for a three night period at each trap site, and the bait used was a mixture of oats, peanut butter, and sardines in oil. Bait was removed from traps during the day to reduce ant attraction to the trapping area.

All trapped animals were identified and released near the capture point.

4.4.4 Bird Survey

Birds were surveyed within each survey site. Bird counts were carried out using binoculars and call recognition during the early morning (6:30 am – 8:30 am) and in the late afternoon (4:30 pm – 5:30 pm). Additional incidental bird sightings were recorded whilst driving in the project area.

The dawn chorus of bird calls was recorded at six trapping sites using a Song Meter SM2+ (see below).

4.4.5 Bat Survey

Bat species present were assessed by using a Song Meter SM2+, which was set up in a central location at six separate trapping sites. The Song Meter, which is able to record birds, amphibians and bats, was set up during the early part of the evening and recorded calls throughout the night and the early morning. The Song Meter has been configured to record the half hour prior to sunrise and the following hour after sunrise, thus capturing the dawn chorus of bird calls. A sound activated ultrasonic microphone records bat calls during the night.

Dr Kyle Armstrong from Specialised Zoological was contracted to analyse all bat call sequences and provide a summary report noting bat species presence.

4.4.6 Active Searches

Each survey site was actively searched twice for fauna including one daytime morning search and one nocturnal search.

Active searches lasted 20 to 30 minutes and involved:

- Turning rocks and logs, raking through leaf litter and grass, looking under bark, behind trees, in crevices, etc.
- Nocturnal searches looking for eye-shine using a spotlight

Opportunistic observations made while travelling between quadrats were also recorded in an 'incidentals' list.

4.4.7 Habitat Assessment

For this report, habitat assessment was undertaken as part of the vegetation mapping exercise (described in Section 4.3).

4.4.8 Targeted Surveys

Based on the results of the desktop review and local traditional knowledge, additional survey effort was directed towards the location of Greater Bilby (*Macrotis lagotis*) and Brush-tailed Mulgara (*Dasymercus blythi*). This effort involved the following methods:

- Spotlighting around areas that may be suitable for these species.
- Walking survey transects (in the daytime) through suitable habitat in search of burrows, diggings, tracks and scats of Greater Bilby and Brush-tailed Mulgara.
- Installing camera 'traps' (i.e. motion-activated with infra-red for night photography) at active Bilby burrows that were found during active searches.
- Driving road transects through the project area at night.
- Mapping appropriate land units (i.e. landform, soils and vegetation) to determine possible extent of possible foraging and burrowing grounds in the local area.

Additionally, environmental staff from ABM have also been conducting transects in search of Greater Bilby burrows to improve dataset for their operational areas and surrounds. This will be an on-going program that will be maintained in a specially created database.

Current survey effort for Greater Bilby and Brush-tailed Mulgara is presented and discussed in Section 5.4.5.

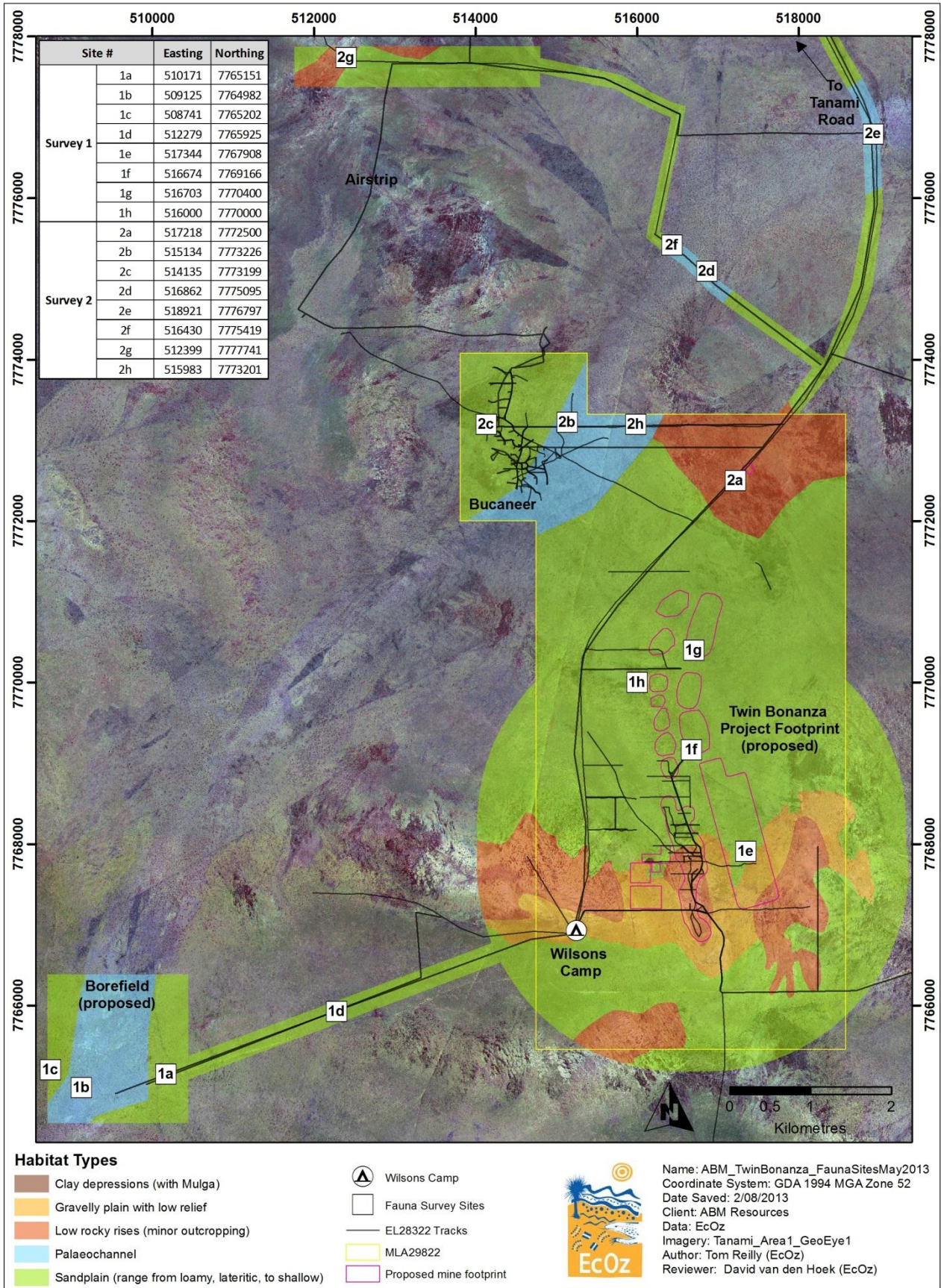


Figure 7. Map of fauna sites for the May 2013 surveys, Twin Bonanza Project.

4.5 Data Limitations

- The results of these surveys are only a snapshot in time, and do not allow for temporal variations or species migrations.
- Sampling, as against undertaking a census, is logistically necessary due to limited human resources.
- Moreover, a larger degree of sampling is required to account for all the above mentioned variations with a high level of confidence.
- Sampling is logistically necessary due to resources – can never capture the full range of variations.
- Scats cannot always be correctly attributed to species, however where they can be confidently identified, they provide an accurate indication of the presence and habitat preferences of certain species (Telfer et al 2006).
- Detection of nocturnal species by spotlight potentially only detects about 25% of the animals present (e.g. Goldingay & Sharpe 2004), and is affected by environmental factors (Wayne et al 2005).
- Specific survey conditions can be selected to improve spotlight detection efficiency (Wayne et al 2005).
- Read & Moseby (2001) concluded that environmental factors affect capture rates. Unfortunately, planning logistics for fauna surveys such as this around specific environmental conditions is very difficult. Planning to survey in the Dry season allows the best chance of favourable conditions.
- The trapping and search methodologies utilised in this study predominantly targeted only threatened species identified during desktop surveys and therefore did not necessarily provide an unbiased or complete indication of species diversity within an area or allow for other threatened species not identified on the database (Moseby & Read 2001; Cunningham et al 2005; Thompson et al 2005).
- Fauna and Flora Atlas records are biased toward previous NT Government survey sites and accessible sites often recognised for their unique biodiversity. Therefore, a lack of records at any particular site is more likely to indicate that the area has not been previously surveyed rather than indicate that various species are not present in the area.

5 Survey Results

5.1 Climatic Conditions

The field survey was undertaken between 9 and 16 May 2013, coinciding with the start of the dry season in northern Australia. The Twin Bonanza project area falls within the northern Tanami and often has fairly consistent influences from monsoonal weather systems from the tropics.

The Tanami region has two distinct seasons that include hot summers (typically dry) and mild dry winters (with cold nights). Historic data indicates that average annual rainfall at Rabbit Flat is 485 mm, of which most falls between November and April due to influences from monsoonal weather systems. This temporal differences highlights the importance of conducting biological surveys in certain times of the year to capture true representation of species assemblages. Ideally, to capture high diversity of species surveys should be conducted after significant rainfall events in periods that still have hot days and warm nights (however this cannot always occur due to the unpredictability of arid zone climate).

The closest weather station is located at Rabbit Flat, approximately 90 km to the east. ABM are planning to install an onsite weather station to collect a variety of climatic data, as there is a high degree of variability due to the localised weather systems in the region (i.e. especially rainfall).

In the 12 months prior to the May 2013 surveys Rabbit Flat recorded 254.7 mm of rainfall, which is below average for this part of the Tanami Desert (Figure 8). A cool weather change and low rainfall occurred during the survey period, which impacted on reptile searches and unfortunately washed away fauna tracks and other signs that may have been present. The first two days of the survey experienced hot days and warm nights, and the remaining days were cool and overcast with consistent light rainfall (see Figure 9 for daily temperature range and rainfall totals for the survey period).

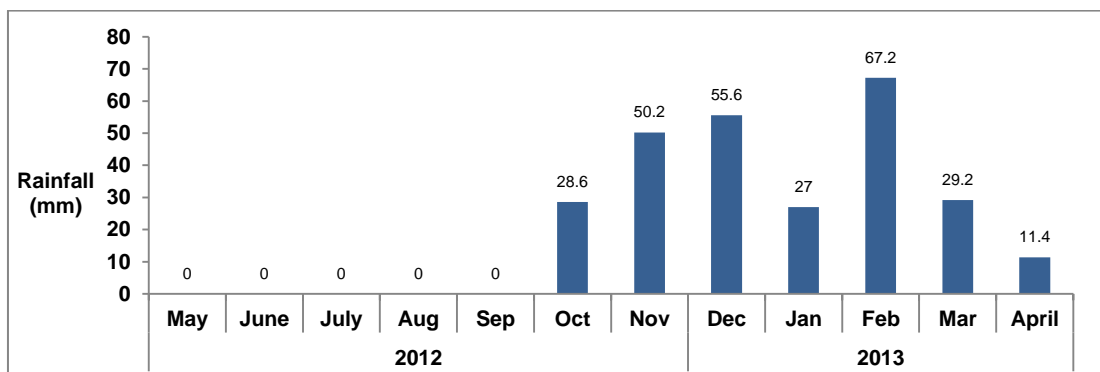


Figure 8. Monthly Rainfall at Rabbit Flat in year prior to survey

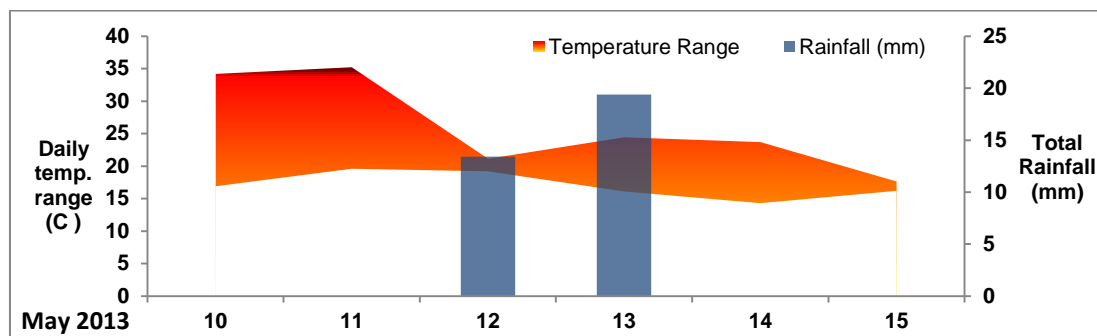


Figure 9. Daily temperature range and rainfall at Rabbit Flat Weather Station during field survey

5.2 Land Units

Existing land unit mapping identified that six land units are located within the project area, including rocky rise, elevated drainage depression, lateritic sand plain, loamy sand plain, shallow sand plain, and palaeochannel (Figure 10). Each of these are described below and discussed in relation to Twin Bonanza.

- Rocky rise – 2593 ha (62%) within project area. Low rises usually covered in lateritic or ferricrete rubble and pediments or minor rock outcropping (including granites, quartz, and silicified sandstone). There are several low lying exposed outcrops (quartz and lateritic) within the project area (which have very little vegetation with little or no soil present), however most of the rocky rise land unit comprises of lateritic gravel or shale coated surface, with a sandy soil profile with high rock/pebble content.
- Palaeochannel – 461 ha (11%) within project area. Palaeochannels (sometime referred to as palaeodrainage systems or channels) are characterised by being the surface expressions of ancient river systems and watercourses. There are two distinctive types (known as Type 1 and Type 2). Type 1 is the saline system associated with salt lakes, and soils affected by various salts including sodium chloride and gypsum and others, but not encountered in or close to Twin Bonanza. Type 1 palaeochannels often have large termite mounds (*Nasutitermes triodiae*) and hold the highest biodiversity values. Type 2 is the drainage depressions appear not to be so affected by salinity, or where the salinity has been masked by overlying sediments such as aeolian or alluvial sands.

Only Type 2 palaeochannel were found in this study area. They are characterised by buried valleys covered with deeper sands in usually more elevated situations (if only slightly) than the saline areas of Type 1. These are often the courses of ancient watercourses (as are Type 1), and are characterised by vegetation types more similar to the surrounding sandplains. Tall (>10 m) trees are commonly found in these systems. They are characterised by narrow to broad drainage depressions of usually diffuse drainage with sandy red-brown earths. The soils are richer and better watered than the surrounding adjacent country, and there may be a higher clay content.

Palaeochannels (especially Type 1) have high biodiversity values due to high diversity and abundance of flora species (and therefore resources), support many microhabitat, support tree species with hollows, and often associated with salt lakes. It is a well-known refugia habitat for many fauna species, including threatened species.

- Elevated drainage depression – 130 ha (3%) within project area. Depressions often nested within sand plains that contain high clay and loam content. Low representation within the project area and surrounds. Can be regarded a fauna refuge during drought periods.
- Lateritic sand plain – 170 ha (4%) within project area. Deep red sands with laterite gravel. Relatively common in the area. At the surface, it looks like a standard sand plain, however there is a high level of laterite gravel within the soil profile. Very low relief plains with sparse to medium cover of spinifex and shrubs, some tall shrubs and small to medium trees to 10 m or more, sparsely scattered. Sands are relatively deep, often over 3 metres and down to over 30 metres in places. Often has a high species diversity in good seasons when food resources are plentiful.
- Loamy sand plain – 801 ha (19%) within project area. Red sands with a deep and soft soil profile. This is the most widespread land unit in this region of the Tanami and generally have no to low rock content and a low clay content. Often covered in hummock grassland with a patchy mosaic of Acacia and isolated *Corymbia opaca*. All other details are similar to lateritic sand plain.
- Shallow sand plain – 24 ha (1%) within project area. Sometimes referred to as sandsheet land unit. Red sands with a shallow soil profile. Very similar to the sandplains, but with a thinner cover of sand, usually less than 1 metre, over rock or clay, distinguished by lower vegetation and sparser cover, and frequent to occasional stony surface and infrequent stony outcrops.

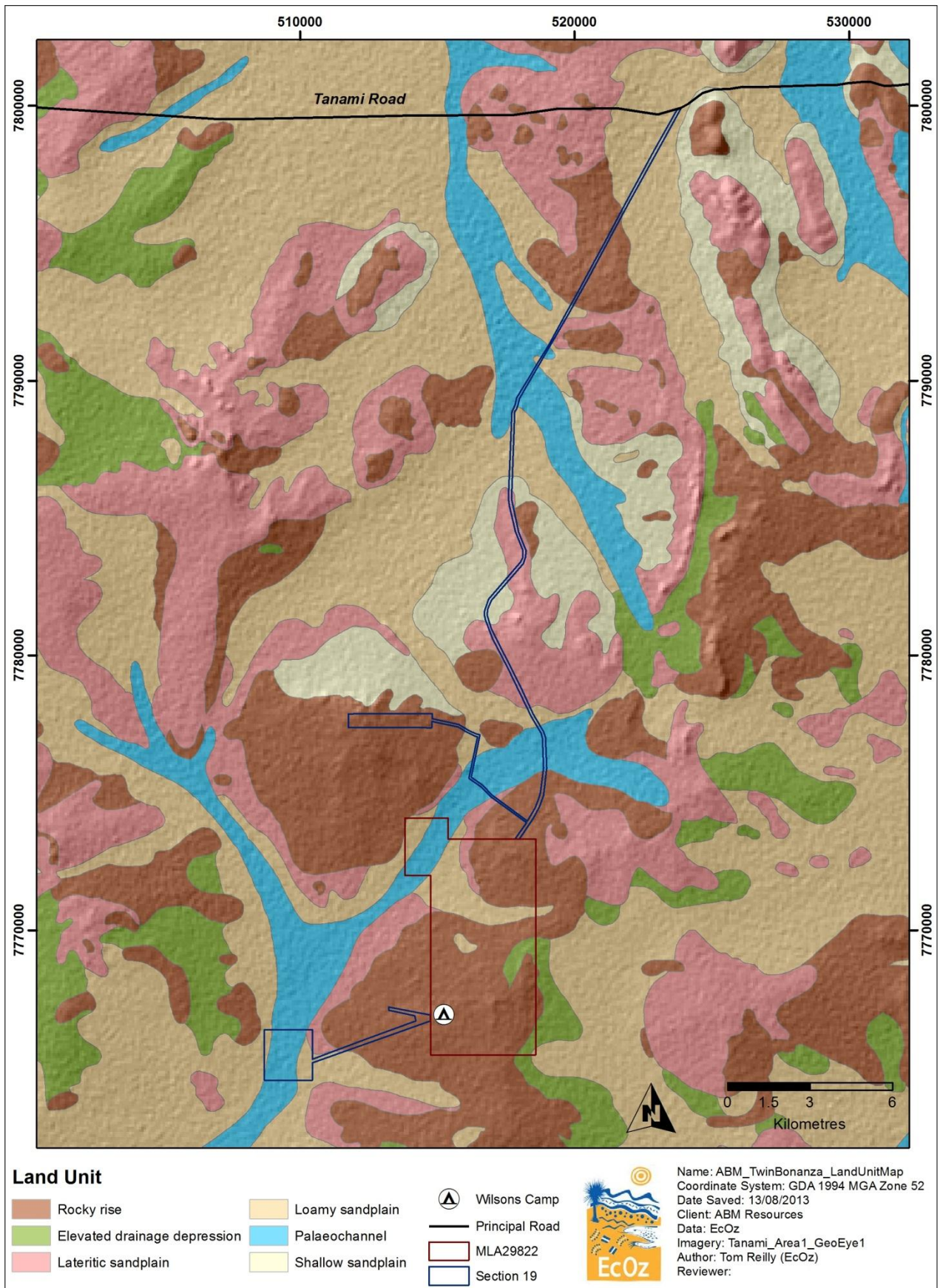


Figure 10. Land Unit map of the Twin Bonanza Project area (and surrounds).

5.3 Vegetation Assessment

5.3.1 Overview

Flora surveys were undertaken to gain the following information:

- Identify flora species encountered during the survey, targeting threatened species, near threatened species, and weed species.
- Describe the habitat within project area.
- Define and map vegetation types within the project area to a scale of approximately 1:30 K.
- Identify presence of sensitive vegetation types.

Flora surveys in May 2013 identified a total of 102 species (see Appendix E for species list). No threatened or near threatened species were identified (under Northern Territory or Commonwealth legislation). One Data Deficient (DD) species, *Trachymene villosa*, and three Not Evaluated (NE) species were located during the survey, including *Clerodendrum floribundum*, *Ehretia saligna*, and *Evolvulus alsinoides*. These classifications indicate that more data is required to accurately assess the conservation status of a species.

Surveys have concluded that 5 main vegetation types occur within MLA29822 and Section 19 (see Section 5.3.3). No significant habitat or vegetation types were identified, however we have noted that palaeochannel required attention to ensure minimal impact is incurred as they hold a high conservation value in the Tanami Desert (see Sections 5.3.4).

To our knowledge, no culturally significant species were identified, however this will need to be confirmed by consultation with Traditional Owners and the Central Land Council.

Three Buffel Grass (*Cenchrus ciliaris*) infestations were located within the project area (obvious legacy from previous land managers). Infestations were at the Tanami Road junction, Wilsons Camp, and Wilsons Bore (described in Section 5.3.5).

A full list of flora species for the project area and surrounds is presented in Appendix G (totals 315 species), which includes previous flora survey records collected from the Old Pirate bulk sampling project (GHD 2012) and also NT Atlas records supplied by DLRM data request (10 km radius from Wilson's Camp). This dataset indicates that 180 species have been identified within the Twin Bonanza Project area, none of which were threatened under Northern Territory or Commonwealth legislation.

5.3.2 Site Description Summaries

Sixteen full reference sites and eight check sites were described during the flora survey. A brief description of each site is provided in Table 5 and full set of habitat description details in Appendix F. The total flora species lists for the survey and each survey site is provided in Appendix G.

In most circumstances, full reference sites occurred within fauna survey locations (with the exception of 1a).

Table 5. Vegetation survey sites and vegetation descriptions within each vegetation type.

Vegetation type 1	
VS 2G	Low <i>Eucalyptus brevifolia</i> isolated trees over <i>Triodia basedowii</i> sparse hummock grassland
CS 3	Low <i>Eucalyptus brevifolia</i> isolated trees with low <i>Acacia hilliana</i> isolated shrubs over <i>Triodia basedowii</i> sparse hummock grassland
CS 7	Low <i>Hakea lorea</i> trees with mid high <i>Acacia lysiphloia</i> shrubland over <i>T. basedowii</i> , open hummock grassland
Vegetation type 3	
VS 1C	Low <i>Corymbia opaca</i> open woodland with tall <i>Acacia tenuissima</i> and <i>A. sericophylla</i> open shrubland over <i>Triodia pungens</i> open hummock grassland
VS 1D	Low <i>Eucalyptus brevifolia</i> open woodland over <i>Triodia pungens</i> and <i>T. schinzii</i> open hummock grassland
VS 1E	<i>Triodia schinzii</i> open hummock grassland
VS 1F	Low <i>Hakea lorea</i> isolated trees with mid high <i>Grevillea wickhamii</i> and <i>Eucalyptus brevifolia</i> isolated shrubs over <i>Triodia schinzii</i> sparse hummock grassland
VS 1G	Low <i>Corymbia aspera</i> isolated trees with tall <i>Grevillea wickhamii</i> open shrubland over <i>Eragrostis eriopoda</i> and <i>Triodia schinzii</i> open tussock/hummock grassland
VS 1H	Low <i>Eucalyptus brevifolia</i> isolated trees over <i>Triodia pungens</i> sparse hummock grassland
VS 1I	Low <i>Acacia adsurgens</i> and <i>A. ancistrocarpa</i> open woodland over <i>Triodia pungens</i> and <i>T. basedowii</i> open hummock grassland
VS 2A	Low <i>Eucalyptus brevifolia</i> isolated trees over low <i>Triodia basedowii</i> sparse hummock grassland
VS 2C	Low <i>Hakea lorea</i> isolated trees with low <i>Acacia lysiphloia</i> , <i>Eucalyptus brevifolia</i> and <i>E. gamophylla</i> open woodland over <i>Eulalia aurea</i> open tussock grassland and <i>Triodia pungens</i> hummock grassland
CS 1A	Low isolated <i>Eucalyptus victrix</i> and <i>Acacia sericophylla</i> trees with mid high <i>A. tenuissima</i> shrubland over <i>Triodia pungens</i> and <i>T. basedowii</i> open hummock grassland
CS 2	Low <i>Acacia sericophylla</i> isolated trees over <i>Triodia pungens</i> open hummock grassland
CS 4	<i>Corymbia opaca</i> isolated trees over <i>Triodia pungens</i> sparse hummock grassland
CS 5	Mid high <i>Grevillea wickhamii</i> shrubland over low <i>Triodia bitextura</i> sparse hummock grassland
CS 6	<i>Triodia basedowii</i> sparse hummock grassland
Vegetation type 4	
VS 1B	Low <i>Corymbia opaca</i> and <i>Eucalyptus victrix</i> open woodland with tall <i>Acacia sericophylla</i> and <i>Ehretia saligna</i> open shrubland over <i>Triodia pungens</i> open hummock grassland
VS 2B	Low <i>Acacia sericophylla</i> isolated trees with tall <i>A. sericophylla</i> and <i>Eucalyptus victrix</i> open shrubland over <i>Triodia pungens</i> open hummock grassland
VS 2D	Low <i>Eucalyptus brevifolia</i> open woodland over low <i>Triodia pungens</i> open hummock grassland
VS 2F	Low <i>Eucalyptus victrix</i> and <i>Hakea lorea</i> isolated trees over <i>Triodia pungens</i> open tussock grassland
VS 2H	Low <i>Corymbia opaca</i> isolated trees with low <i>Eucalyptus gamophylla</i> and <i>E. brevifolia</i> sparse woodland over <i>Triodia pungens</i> sparse hummock grassland
CS 1	Low isolated <i>Corymbia aspera</i> trees with low <i>Eucalyptus victrix</i> and <i>Acacia sericophylla</i> open woodland over <i>Triodia pungens</i> open hummock grassland
Vegetation type 5	
VS 2E	Low <i>Acacia aneura</i> open forest over <i>Triodia pungens</i> sparse hummock grassland

5.3.3 Vegetation Mapping

This vegetation mapping exercise includes and updates the mapping dataset developed by GHD in 2012 as part of the Old Pirate Bulk Sampling Project (GHD 2012). Vegetation types that were defined in this earlier survey are summarised in Section 3.3.1.

A total of sixteen reference sites and eight check sites were surveyed in order to stratify vegetation types in currently unmapped areas of MLA29822 and Section 19. These sites supplemented 9 sites established in 2012 flora surveys (GHD 2012).

In total, five distinct vegetation types were identified within MLA29822 and Section 19. This survey only contained sites within types 1, 3, 4, and 5 (i.e. type 2 was described during initial flora studies in April 2012). Summary descriptions of vegetation types are described below and illustrated in Figure 6:

- Vegetation type 1: Low *Eucalyptus brevifolia* isolated trees ± mid high *Acacia lysiphloia* or low *A. hilliana* isolated shrubs over *Triodia basedowii* open hummock grassland. Occurs on rocky outcropping.
- Vegetation type 2: *Triodia basedowii* and *T. intermedia* mid open hummock grassland with *Acacia minutifolia* and *A. adoxa* var. *adoxo* low open shrubland. Occurs on gravel flat to gentle relief.
- Vegetation type 3: Open *Triodia* spp. Hummock grassland ± low *Eucalyptus brevifolia* or *Hakea lorea* isolated trees with tall ± *Grevillea wickhamii* or *Acacia* spp. Open shrubland. Occurs in sand plains.
- Vegetation type 4: Low *Corymbia opaca* or *Eucalyptus victrix* ± *Eucalyptus brevifolia* open woodland with tall *Acacia sericophylla* open shrubland over *Triodia pungens* open hummock grassland. Occurs in Palaeochannels.
- Vegetation type 5: *Acacia aneura* woodland over mixed tussock grass. Occurs within a variety of landform, however always present on heavy soils with high clay content.

There is a moderate to high floristic variation within each of the vegetation types described above, therefore it is likely that there will be patches of vegetation within the mapped groupings that do not fit with the descriptions. For example, there are several Mulga (*Acacia aneura*) patches within the project area that are not clearly delineated in 1:30K mapping, but are obvious on the ground. In these circumstances, fire also plays a key role in what species are dominant at the time of survey, therefore species dominance (and even presence) may greatly change over time.

Vegetation mapping identified a mosaic of vegetation structure and composition within Vegetation type 3. The structure of vegetation located within this broad area ranged from *Triodia* sp. Hummock grassland through to low isolated *Eucalyptus* spp. or *Hakea* spp. with *Grevillea* spp. or *Acacia* species tall shrubland. This is likely a result of the large area attributed to this vegetation type. Given the significant area of Vegetation type 3, a total of 14 flora sites were located within this area, which also contributes to the large variation in species composition. The comparatively small areas attributed to Vegetation type 1 and Vegetation type 4 had three flora survey areas applied to the former and seven to the later.

5.3.1 Sensitive Vegetation and Habitat

There are no threatened ecological communities or significant habitat types within the Twin Bonanza Project Area. However, the Tanami Desert is regarded as collectively being “significant habitat” for several threatened species and a diversity of native species (SEWPAC website).

Sensitive habitat types within this part of the Tanami Desert would include ephemeral wetlands, ephemeral salt lakes, and palaeochannels. These habitats are known for their importance in supporting a diversity of native species (including threatened species) and provide a general refugia during dry periods. Additionally, these habitats are not widespread like sand plain habitats and also have the potential for fragmentation due to a relatively linear landform structure.

As introduced and described in Section 5.2, the Twin Bonanza Project Area does contain a palaeochannel. Palaeochannels (or paleodrainage systems) are characterised by being the surface expressions of ancient river systems. There are two distinctive types. Type 1 is the saline system associated with salt lakes, and soils affected by various salts including sodium chloride and gypsum and others. Type 2 is the drainage depressions which today appear not to be so affected, or where the salinity has been masked by overlying sediments such as aeolian or alluvial sands. Vegetation and habitat surveys of the palaeochannels within the Twin Bonanza project area fit the description of Type 2 Palaeochannel system.

The first type (TYPE 1), described by Lundie-Jenkins (1989) as *caliche* areas, are characterised by a distinctive vegetation of shrubs (mostly *Melaleuca* tea tree) and several grasses including *Triodia pungens* and *Plectrachne schinzii*. The physical features are low sandy rises in linear dune formations, juxtaposed with flat playas (sometimes known or identified as salt lakes) with vegetation very different from the dunes. The soils are often highly gypseous and may contain a large clay fraction. These areas are considered nutrient rich by comparison with the sandy areas of the desert. There are often large termite mounds (>2 m) in these areas.

The other type (TYPE 2) is characterised by buried valleys covered with deeper sands in usually more elevated situations (if only slightly) than the saline areas of Type 1. These are often the courses of ancient watercourses (as are Type 1), and are characterised by vegetation types more similar to the surrounding sandplains. Tall (>10m) trees are commonly found in these systems. They are characterised by narrow to broad drainage depressions of usually diffuse drainage with sandy red-brown earths. The soils are richer and better watered than the surrounding adjacent country, and there may be a higher clay content.

Representative photographs of Type 1 and Type 2 Palaeochannel are provided in Figure 11 and Figure 12. Photos a flooded palaeochannel south of Rabbit Flat in March 2006 is provided in Figure 13. Palaeochannel boundaries are most obvious when in full flood, which is not a common occurrence. One of the last major widespread rainfall events of the Tanami occurred in 2007, which resulted in Type 1 and Type 2 palaeochannels being clearly visible by air (Figure 14).

Palaeochannels hold several cultural values as they typically provide a concentration of food resources, surface water (for short periods after rainfall), shade trees, and orientation features important for travel.

5.3.1 Culturally Significant Species

ABM have worked closely with Traditional Owners, Elders and Indigenous groups (through the Central Land Council) to better understand and minimise potential project impacts on cultural heritage. This information is not within the scope of this flora and fauna report.

No individuals of the Desert Walnut (*Owenia reticulata*) were identified during studies within the project area (this species is of cultural significance to the local Aboriginal people). Other larger trees (*Hakea* spp., *Grevillea* spp., *Eucalyptus* spp., and *Corymbia* spp.) may be significant to Traditional Owners and consultations will determine if the level of significance and protection within the project area. It is likely that significant flora will be associated with palaeochannels.



Figure 11. Photo of Type 1 Palaeochannel near Rabbit Flat (dry period in 2005)



Figure 12. Photo of Type 2 Palaeochannel at Twin Bonanza (dry period 2013)

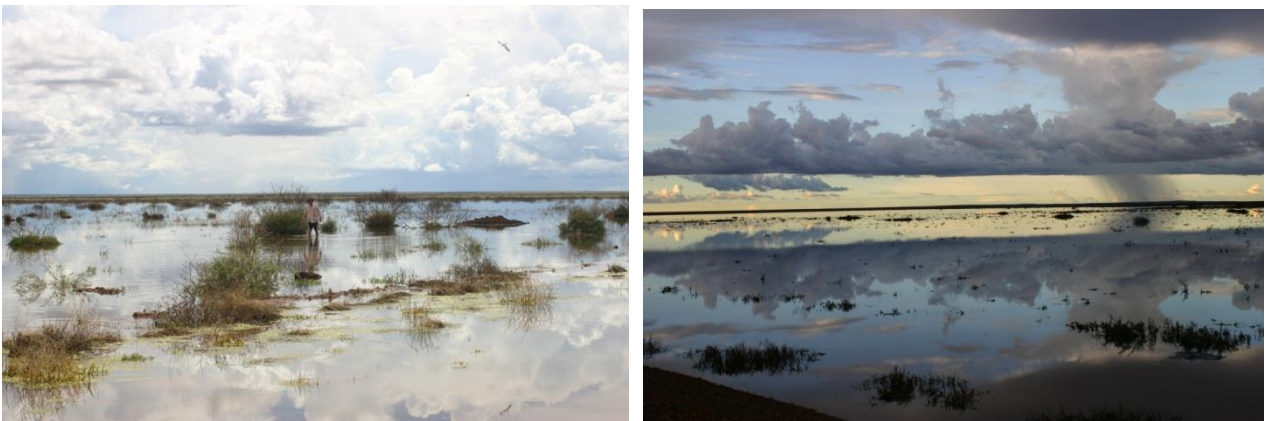


Figure 13. Photos of Type 2 Palaeochannels in flood after Feb 2006 rains, just south of Rabbit Flat.

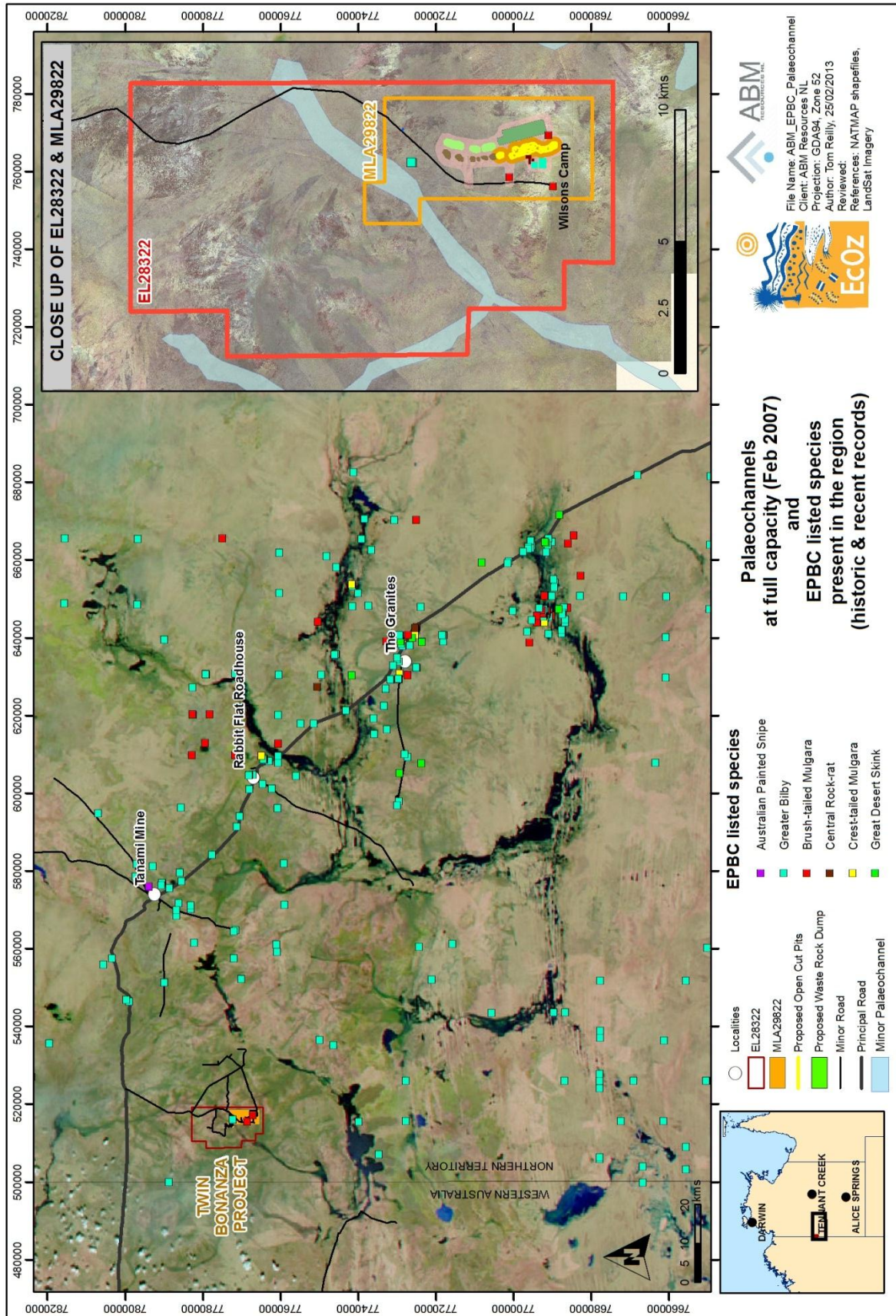


Figure 14. Palaeochannels in full flood (plus threatened species records)

5.3.2 Vegetation Condition

The condition of vegetation within the project area can be described as largely intact native vegetation. The only obvious impacts (apart from minor surface disturbances from exploration practices) are fire, weeds, and camels all of which are relatively minor in the project area.

Fire Impact

Fire is a frequent and significant factor in the desert landscapes of this region, and strongly influences the structure and composition of the vegetation in the region (Latz 1995). Fire complicates interpretation of the boundaries and land types represented, and vegetation is not always a reliable key to interpretation (which is why land units are described in Section 5.2 as land units include soils type, land form, and vegetation characteristics).

Fire scar mapping data (NAFI 2013) has identified that a large portion of the project area was burnt in 2011 and that areas in the south of lease have remained unburnt between six and seven years (Figure 15). Areas to the north of the MLA29822 boundary also remained unburnt in the 2011 fire with patches remaining unburnt for a maximum of 11 years (Figure 15). Surveys in the southern portion of MLA29822 in the mature hummock grasslands detected Rufous-crowned Emu-wren, which is known as an indicator species in the Tanami for long un-burnt areas. Searches in this area also seemed to detect high abundance (and possibly diversity) of reptile species.

Weeds

The vegetation surveys identified three weed infestations, all related to Buffel Grass (*Cenchrus ciliaris*) and previous land clearing practices (obviously a legacy issue adopted by ABM).

Weed infestations were identified at following sites:

- Wilsons Camp. Several small Buffel Grass patches located in disturbed areas across the camp area. Minor amount of Purple-topped Rhodes Grass. There is no evidence that weeds have spread outside of the camp area at this stage (see Figure 1 for point locations).
- Wilsons Bore. Buffel Grass infestation surrounding the cleared bore pad. Most probably spread by machinery used to clear the camp area.
- Junction of Tanami Road and Wilson Camp access road. It occurs on each side of the access track, and also on the northern side of Tanami road. It is evident that earthworks associated with the establishment of Wilsons Camp access track are responsible for introduction of Buffel Grass at this site. We are unsure whether this falls within jurisdiction of ABM land management requirement, but figured it was important to highlight as this area may be a source of weed issues for the local region.

No weeds were identified along exploration tracks, drill pads, water bores, general roads, airstrip, or other areas within the Twin Bonanza project area. Purple-top Rhodes Grass (*Chloris barbata*) is present in low numbers at Wilsons Camp but is not generally regarded as a threat to native biodiversity (therefore has low priority of control).

Weed control (and management) needs to focus on Buffel Grass, as this species is responsible for significantly changing the ecological function of landscapes in central Australia (such as changing fire regimes, displacement of native flora, and altering habitat availability for fauna) (CRC 2008). This species also poses a fire threat to camp infrastructure if infestations are not appropriately controlled.

Herbivores

One-humped Camels (*Camelus dromedaries*) are the only introduced herbivore present in the area that could have widespread and notable impact on vegetation condition. Inspections during the survey did identify the species within the project area but did not record any notable impact on vegetation by this species (perhaps due to a low population in the local area). Larger populations are known to occur further south and further west.

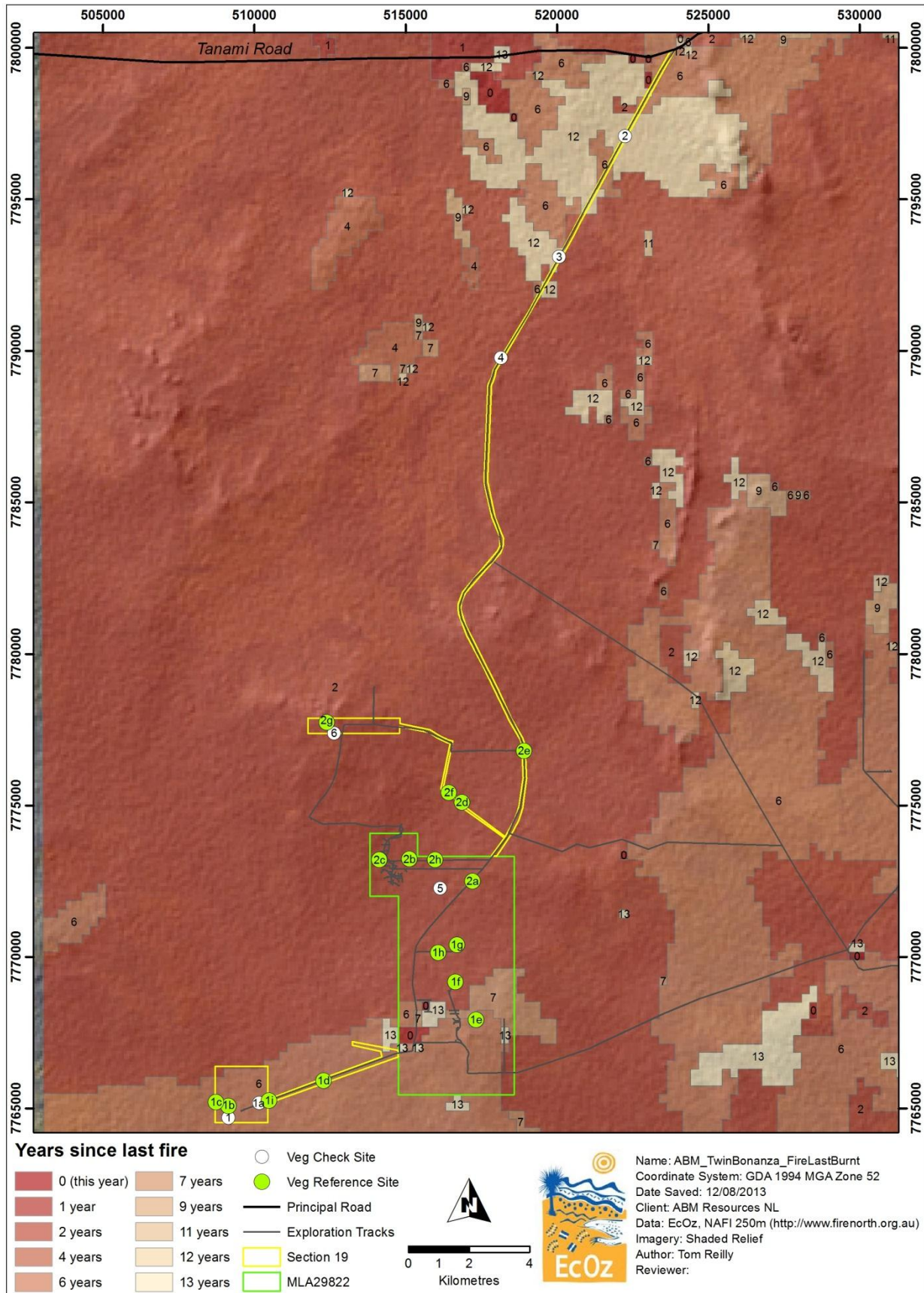


Figure 15. Time since last fire , Twin Bonanza project area

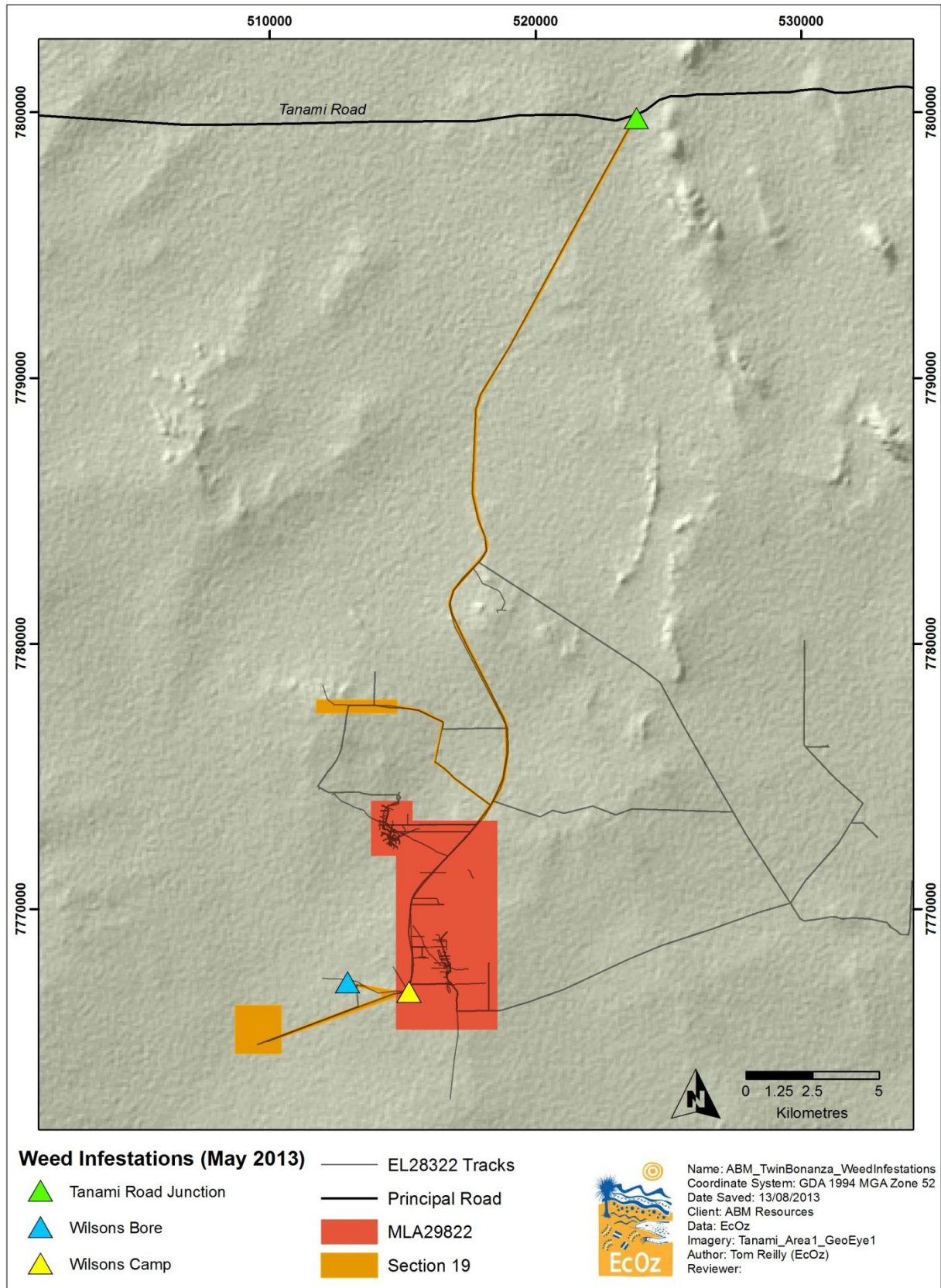


Figure 16. Weed infestations in the vicinity of the Twin Bonanza project area.

5.4 Fauna Surveys

5.4.1 Overview

Fauna surveys were conducted during the early dry season period between 10 and 15 May 2013 (using a variety of methods – described in Section 4.3). These surveys were conducted characterise the existing terrestrial vertebrate biodiversity within the project area (MLA29822 and Section 19) that may be affected by mining operations. This survey follows on from two previous surveys conducted in the dry and wet seasons of 2012, and completes the baseline dataset for the project.

Sixteen sites (plus targeted threatened species searches) were surveyed in areas proposed to be disturbed by mining works associated with the Twin Bonanza Gold Project. A habitat description for each fauna site was assessed and is presented in Appendix F.

A total of 73 terrestrial vertebrate species were recorded within the project area comprising of 16 reptiles, 42 birds, and 15 mammals (Table 6). Refer to Appendix B or a detailed account of survey data. The majority of species were identified through trapping, active search techniques, and incidental observations. Summary descriptions by faunal group are provided below. No amphibians were recorded during the survey.

Two threatened species were recorded (refer to Section 5.4.5 for discussion on these species):

- Brush-tailed Mulgara (*Dasyercus blythi*) – Vulnerable TPWC Act
- Greater Bilby (*Macrotis lagotis*) – Vulnerable TPWC Act and EPBC Act

Two introduced species were recorded during the fauna survey (refer to Section 5.4.6 for discussion on these species):

- Feral Cat (*Felis catus*)
- One-humped Camel (*Camelus dromedaries*)

Table 6. Survey Data Summary Table, May 2013

	Survey Period 1								Survey Period 2								INC	Totals
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H		
Reptile																		
Records	31	8	11	29	18	6	4	4	0	0	0	0	1	0	2	1	58	162
Species	6	6	6	8	6	2	3	2	0	0	0	0	1	0	2	1	10	16
Bird																		
Species	6	5	6	7	3	1	0	4	0	4	0	3	9	0	1	2	21	42
Mammal																		
Records	3	4	3	4	2	2	2	1	3	17	5	3	12	9	5	2	11	87
Species	2	4	3	4	2	2	2	1	3	9	4	2	3	5	5	2	4	15
Total Species	14	15	15	19	11	5	5	7	3	13	4	2	12	5	8	5	35	73

5.4.2 Reptiles

A total of 16 reptiles were recorded during the survey, mainly from pit traps, funnel traps and active searches (Appendix B). Skinks were the most represented family with six species, while four geckos, three dragons and three monitors were also recorded. Military Dragon (*Ctenophorus isolepis*), Central Netted Dragon (*Ctenophorus nuchalis*) and Leopard Ctenotus (*Ctenotus pantherinus*) were commonly sighted throughout the spinifex grass plains while nocturnal searches revealed Spiny-tailed Gecko (*Strophurus ciliaris*), Crowned Gecko (*Lucasium stenodactylum*) and Beaked Gecko (*Rhynchoedura ornata*) to be common in the project area. One Spiny-tailed Monitor (*Varanus acanthurus*) was recorded in a small rocky outcrop during an active search while signs of Sand Goanna (*Varanus gouldii*), including burrows and fresh diggings, were seen at several sites and incidental observations across the project area.

The first two days of the survey (May 10 and 11) experienced relatively hot climate in the project area, including warm nights (see Section 5.1). On these days reptiles were sighted on a regular basis. On the second trapping night an extensive weather system brought a cool change to the project area (see Section 5.1). Following the cool change reptile sightings in the project area decreased as their low metabolic rates allow them to become inactive during unfavourable climatic conditions (Read & Moseby 2001). Very few reptile sightings were recorded during the second part of the survey due to cool weather, and rainfall covered many tracks.

Notable results from the reptile surveys included:

- One Tanami Ctenotus (*Ctenotus tanamiensis*) was captured at Site 2G which is located in a rocky area adjacent to the existing airstrip (see photo in Appendix I). The species was described in 1970 and is endemic to the Tanami Desert (Storr 1970). It is uncommon and prefers sand plain habitats with an understory of hummock grasses (Horner 1992).
- One Narrow-banded Sand-swimmer (*Eremiascincus fasciolatus*) was caught in a pit trap at site 1C (see photo in Appendix H). This species was not recorded during previous surveys in April (GHD 2012) and September (EcOz 2012) of 2012.
- One Spiny-tailed Monitor (*Varanus acanthurus*) was hand caught during active searches on a rocky outcrop within the proposed mine area (see photo in Appendix H).
- No threatened reptile species were recorded in the project area

5.4.3 Birds

A total of 42 bird species from 22 families were recorded during the survey (Appendix B).

Bird diversity was similar to previous surveys in the project area with records of 49 and 27 species during the April and October surveys of 2012 (GHD 2012; EcOz 2012). Bird diversity was low overall, reflecting the habitat structure of the project area. Habitat complexity is an important determinant of species richness in birds (Cousin & Phillips 2008). Vegetation cover throughout the project area is generally low, with large trees and shrubs sparsely scattered throughout. In most areas the upper and middle canopy is either very open or absent, which limits foraging and roosting options for birds. Bird communities of spinifex grasslands typically have few species and are low in abundance (Reid 1999), which is reflected in results across all surveys undertaken in the project area.

Bird diversity appeared to increase following the cool change and associated rainfall. This is likely to be due to the increased availability of surface water within the project area as well as the increased availability of food, including seed, nectar and invertebrates. Following the cool change birds were generally more active and visible throughout the day, as opposed to the warmer days when birds were most active in the mornings and evenings but were relatively inactive during the hotter parts of the day.

The most commonly encountered species were Zebra Finch (*Taeniopygia guttata*), Black-faced Woodswallow (*Artamus cinereus*), Budgerigar (*Melopsittacus undulatus*) and Grey-headed Honeyeater (*Lichenostomus keartlandi*). Brown Falcon (*Falco berigora*) was the most commonly observed bird of prey, while Black-shouldered Kite (*Elanus axillaris*) and Nankeen Kestrel (*Falco cenchroides*) were only observed following rainfall. These species likely migrated to the project area to exploit the increased availability of rodent and invertebrate prey.

Notable results from the bird surveys included:

- A Black Falcon (*Falco subniger*) sighted near camp preying on Zebra Finches (*Taeniopygia guttata*) drinking at a sprinkler at Wilson's Camp. This uncommon species was recorded during the survey in September 2012 (Appendix I).
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) was recorded at sites 1A and 2C, and also several incidental sightings. While this species is not listed as threatened populations have declined due to land clearing and a reduction in the availability of nesting hollows (Birdlife Australia 2013) (Appendix I).
- Two groups of Rufous-crowned Emu-wrens (*Stipiturus ruficeps*) were recorded during the pre-clearance surveys. The species was recorded in Spinifex grassland just outside the area of impact (Appendix I).
- No threatened bird species were recorded in the project area.

5.4.4 Mammals

A total of 15 mammals from 10 families were recorded during the survey (Appendix B).

The trapping success rate for mammals was much greater during the second survey period (13-16 May) where sites were set at Buccaneer and airstrip access roads, compared to the first survey period (10-13 May) in the Old Pirate and proposed bore field. For example, a total of 10 mammals were trapped during the first survey period compared to 48 mammals trapped during the second. This result may be due to the change in location; however, the change in weather may also be a factor. Paltridge and Southgate (2001) found that geographic location and climatic conditions in the Tanami Desert were more important factors affecting small mammal abundance than vegetation type. The highest trapping rate occurred on the last night of the survey when 25 mammals were trapped. Interestingly the last trapping day (May 15) was the coolest day of the survey with a maximum temperature of 17.6°C with rain occurring for much of the day and most of the following night. The higher mammal trapping rate can be attributed to increased activity rather than migration or breeding factors.

The most commonly trapped mammal was Stripe-faced Dunnart (*Sminthopsis macrourus*) which was trapped 22 times, followed by Spinifex hopping Mouse (*Notomys alexis*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and Western Chestnut Mouse (*Pseudomys nanus*) which were trapped 16, 11 and four times respectively. Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*) and Brush-tailed Mulgara (*Dasyercus blythi*) were both trapped on two occasions while Fat-tailed Antechinus (*Pseudantechinus macdonnellensis*) was trapped once.

Red Kangaroo (*Macropus rufus*), which was recorded at Site 2G, was the only Macropod species encountered in the project area.

Gould's wattle bat (*Chalinolobus gouldii*) was the only bat species recognised at being present during the survey. The identification was deemed unambiguous, needing confirmation through further investigation (refer Appendix C).

Notable results from the mammal survey included:

- Two Brush-tailed Mulgara (*Dasyercus blythi*) were captured, including one individual at Site 1F and one at Site 2C. This species is listed as Vulnerable under the TPWC Act and EPBC Act (as *Dasyercus cristicauda*) (Appendix I).
- Greater Bilby (*Macrotis lagotis*) was recorded at site 1E. Two active Bilby burrows were discovered in the site and numerous fresh diggings were also observed. A camera trap set up at one of the burrows recorded photos and video of an individual. This species is listed as Vulnerable under the EPBC and TPWC Acts. One additional active burrow was located in the Old Pirate prospect. Several other burrows have been located within the general project area and these are described and mapped in Section 5.4.5 (Appendix I).
- The Western Chestnut Mouse (*Pseudomys nanus*) was recorded at Sites 1B, 2D, 2E and 2F. This species is listed as Near-Threatened in the Northern Territory.
- Two introduced species, Camel (*Camelus dromedaries*) and Feral Cat (*Felis catus*), were recorded during the survey. Predation by Feral Cat has been listed as a Key Threatening Process under the EPBC Act. Cats have been identified as a threat to several native species including small to medium sized mammals such as the Bilby. Feral Camels are seen as less of a threat to the environment; however, increasing densities of the species pose the threat of significant negative impacts, such as broad landscape damage to vegetation and wetlands. A national feral camel action plan has been developed by the Australian Government (SEWPAC 2010).

5.4.5 Threatened Species

Of the 11 threatened species identified as potentially occurring within the project area (refer to Section 3.4) two were recorded during the terrestrial vertebrate fauna survey:

- Brush-tailed Mulgara (*Dasyercus blythi*) – Vulnerable under the TPWC Act
- Greater Bilby (*Macrotis lagotis*) – Vulnerable under the TPWC Act and EPBC Act

These species were recorded in fauna surveys undertaken at the Old Pirate prospect in April and September 2012 (GHD 2012; EcOz 2012). Additionally, there were no other threatened species identified onsite during the previous surveys within Twin Bonanza (GHD 2012; EcOz 2012).

As these species are known to occur within the Twin Bonanza Project Area, specific management measures will be required to be implemented during the environmental approvals process. Therefore, a detailed description of the likely presence of each species within the project area and a summary of their ecology is provided below.

Location points for each species in relation to proposed infrastructure has been mapped in Figure 17 (please note that infrastructure location may change during the risk assessment process of the EIA – therefore, do not use this figure as a final reference for infrastructure design/layout).

A threatened species database has been created that can be easily updated when new records are available. The database has been setup in Excel and is compatible for use in ArcGIS mapping software. The database includes sightings, burrows, and other signs.

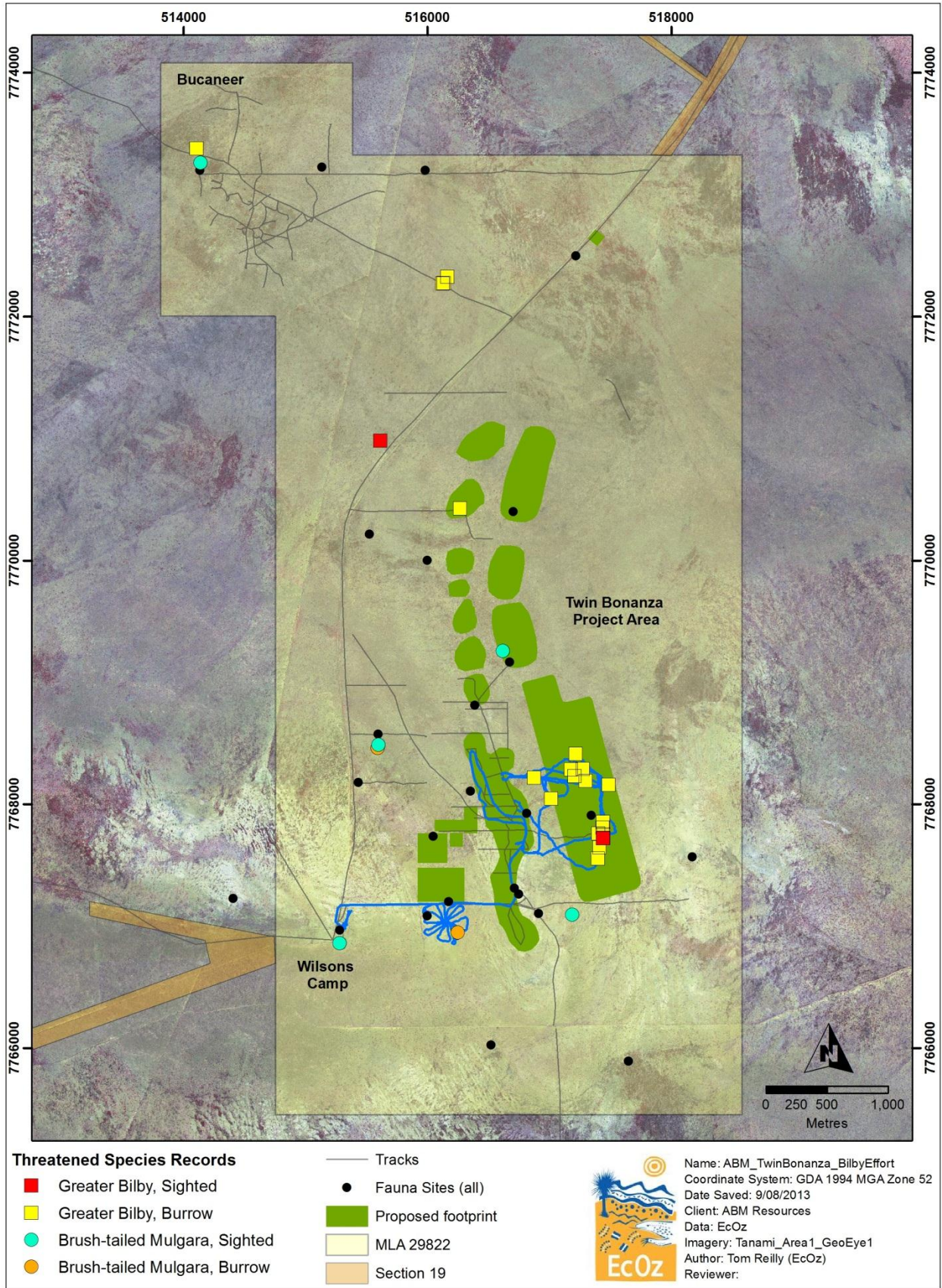


Figure 17. Threatened species locations

Brush-tailed Mulgara (*Dasyercus blythi*)

Status – Vulnerable under the TPWC Act. Not currently listed under the EPBC Act.

Presence within Twin Bonanza – Two Brush-tailed Mulgara (*Dasyercus blythi*) were trapped during the fauna survey including one in the Old Pirate prospect at site 1F and one in the Buccaneer prospect at site 2C. Several potential burrows were also identified. Previous surveys also located this species at a variety of locations (see Figure 19). The occurrence of Brush-tailed Mulgara is likely influenced by a number of factors, including rainfall, food resources, burrow availability and fire age. At a local scale density of the species is affected by factors such as competition and predation. The availability of burrow sites may be an important determinant of distribution (Dickman et al 2001). Suitable habitat for the species occurs throughout the project area (i.e. sand plain) so it would be reasonable to assume that a breeding population is present.



Figure 18. Photographs of Brush-tailed Mulgara captured during the May 2013 surveys.

Ecology – The Brush-tailed Mulgara is a carnivorous marsupial species with a body mass of over 100g. It can be differentiated from the closely related Crest-tailed Mulgara (*Dasyercus cristicauda*) by the presence of two pre-molar teeth (three in *D. cristicauda*), the brush-like appearance of the black hairs in the distal half of the tail (crest-like in *D. cristicauda*) and the female having six teats as opposed to eight teats in *D. cristicauda* (Pavey et al 2006a). Therefore to accurately identify this species it is ideal that caught specimens are inspected.

Brush-tailed Mulgara are predominantly nocturnal, sheltering by day in burrows that are about 0.5m deep. Burrows are fairly conspicuous and are generally 5 cm diameter and often have multiple entrances (but not always) (notes from field experience – Tom Reilly). Typical habitat for the species consists is sand plains and drainage depressions that support mature hummock grasslands of Spinifex, especially *Triodia basedowii* and *T. pungens* (Pavey et al 2006a). Burrows located at Twin Bonanza Project Area were generally built at the base of mature Spinifex hummocks. Maximum life span for Brush-tailed Mulgara in the wild is estimated to be three years (Masters and Dickman 2012).

Brush-tailed Mulgara demonstrates remarkable flexibility in its use of resources and aspects of its behaviour and physiology that protect it from periods of food shortage. It is both carnivorous and insectivorous, taking a range of prey including scorpions, centipedes, rodents, small marsupials and reptiles. Unlike smaller dasyurids, it is able to excavate prey from burrows (Masters and Dickman 2012). The mulgara is able to reduce its energy expenditure *in situ* by entering daily torpor. During periods of drought Brush-tailed Mulgara is able to tolerate reduction in bodyweight and condition by drawing on substantial reserves of fat stored in its tail. The depth of Brush-tailed Mulgara burrows provides additional protection from environmental disturbances, including climatic extremes and intrusions from predators such as the feral cat (*Felis catus*) and Red fox (*Vulpes vulpes*) (Masters and Dickman 2012).

Distribution – Most previous records do not distinguish between the two different Mulgara species (Crest-tailed Mulgara *Dasyercus cristicauda* and Brush-tailed Mulgara *D. blythi*), hence there is some ambiguity regarding the distribution of each species. Brush-tailed Mulgara is believed to have once been widespread in

the desert regions of central Australia. It began to decline in the 1930s and is believed to have a more fragmented distribution than in the past (Pavey et al 2006a). However, recent assessments indicate that both *Dasyercus* species are more widely distributed than previously thought (Masters and Dickman 2012). The Brush-tailed Mulgara is now listed as a species of 'least concern' by the International Union for Conservation of Nature (IUCN, 2010), however it still threatened under the TPWC and EPBC Acts.

Threatening Processes – No specific threatening processes have been identified for the Brush-tailed Mulgara as causes for the species decline are unknown. Possible causes of decline include habitat degradation from changed fire regimes and grazing, and predation by feral cats & foxes (Pavey et al 2006a).

Mulgara and Mining – Efforts have been made in the WA goldfields to monitor the impacts of mining on Crest-tailed Mulgara (*Dasyercus cristicauda*). Unfortunately these studies were hindered by large fluctuations in the species abundance owing to variation in annual rainfall, making it difficult to discern mining impacts from natural changes due to resource pulses (Pearson 2003).

In 1994 biological surveys by Ecologia at the Jundee Gold Project (Wiluna WA) captured two adult females. These individuals were re-trapped the following two years and showed no signs of breeding, indicating that they may have become isolated from other Mulgaras due to the proximity of mining (Pearson 2003).

Mulgaras were captured at several other prospects in the mid-1990s. The Department of Conservation and Land Management (CALM) worked with wildlife consultants, mining companies and the Department of Minerals and Energy to develop a series of protocols to minimise impacts to the Mulgara from exploration and mining projects. Some of the protocols adopted included:

- 'Softer' techniques for exploration drilling:
 - Clearing fewer tracks
 - Using rubber tyred machinery rather than bulldozers
 - Reusing existing gridlines were possible
- Erecting fencing and signs to protect Mulgara habitat
- Changes made to the positioning of overburden heaps and haul roads where mining and infrastructure is close to Mulgaras

One mining company (Barrick Gold) developed a management plan to protect Mulgaras and included the following measures:

- A compulsory induction course for staff about Mulgaras and techniques to minimise habitat disturbance
- Carefully planned access to drill sites to minimise vegetation clearing and to avoid running over burrows
- No drilling or vehicle movements to be undertaken at night
- Drill pads are promptly rehabilitated after use

Mulgara populations in the drilling area were monitored as well populations in an undisturbed 'control' area. Monitoring was undertaken by trapping and searching for burrows. Despite these efforts Mulgara numbers continued to fluctuate markedly in areas adjacent to mining activity as well as in areas far away from mining disturbance (Pearson 2003).

Response to Fire – Research indicates that Brush-tailed Mulgara is able to persist in regenerating habitat and in the absence of Spinifex (Pavey et al 2011); however, the species is more abundant in mature Spinifex habitat indicating that fire impacts population size (Masters 1993). The deep burrow systems built by Mulgara is one factor that enables individuals to persist in recently burn habitat. Studies in Kata Tjuta National Park indicated that the species occurs in both mature *Triodia basedowii* and open regrowth areas and did not exhibit a preference for either habitat type, though individuals were more prone to mortality by introduced predators in open regrowth areas (Körtner et al 2007).

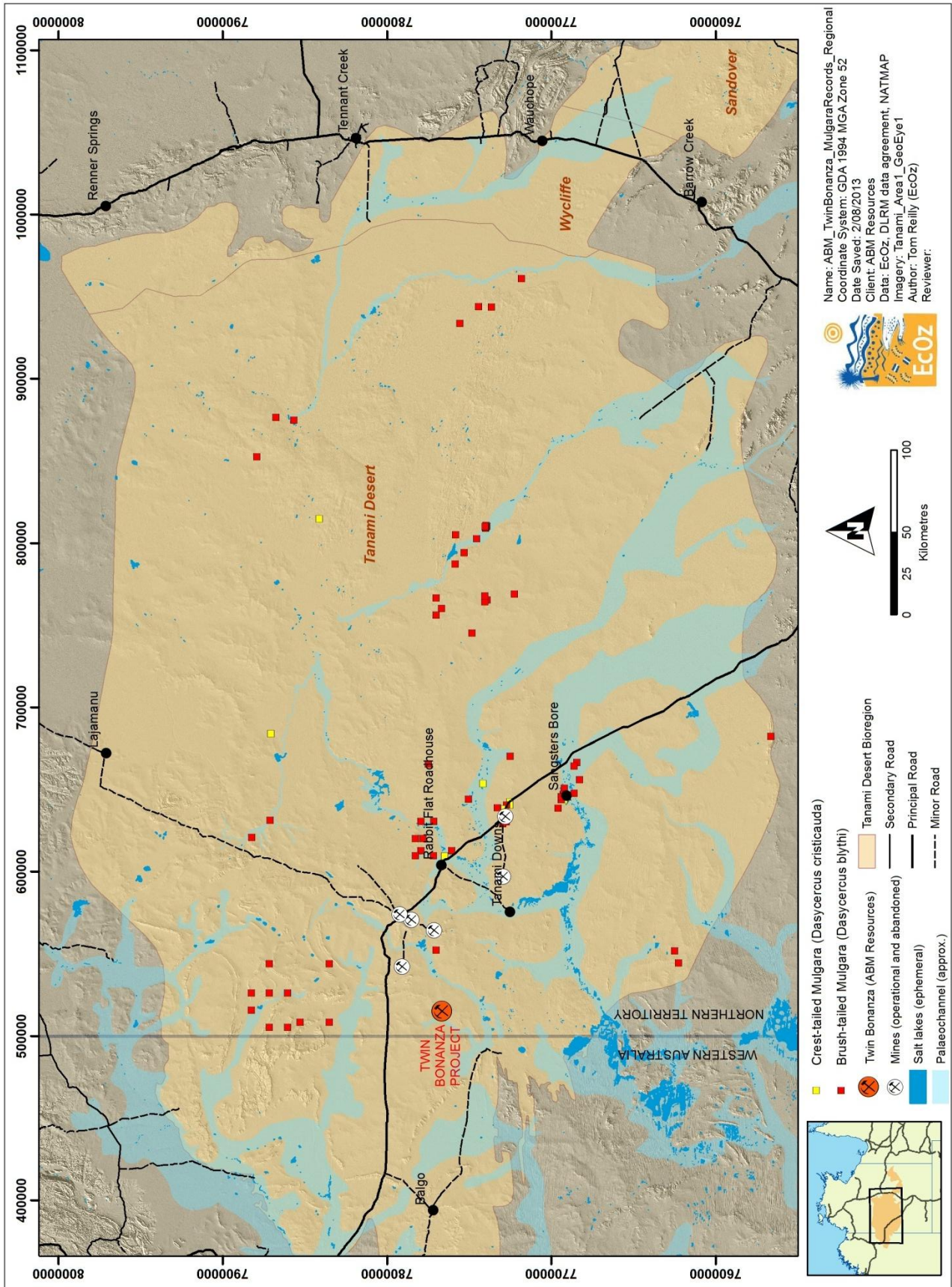


Figure 19. Brush-tailed Mulgara records in the local area around Twin Bonanza

Greater Bilby (*Macrotis lagotis*)

Status – Vulnerable under the TPWC Act. Vulnerable under the EPBC Act.

Presence within Twin Bonanza – Greater Bilby (*Macrotis lagotis*) burrows, sightings, camera trap footage, and fresh diggings have been identified across the project area during recent field studies (see Table 7 and Figure 20, Figure 21 and Appendix I). Several kilometres of targeted search transects have occurred throughout the proposed mining area, and further transect work is proposed to develop a greater understanding of general presence and activity in the local area. This knowledge will be useful when implementing management strategies to minimise impact on the species.

Ecology – The Greater Bilby is a large omnivorous burrowing marsupial. It is nocturnal and generally solitary. Typical habitat for the species in the Northern Territory consists of sandy soils dominated by hummock grasslands covered predominantly by three species of spinifex, *Triodia basedowii*, *T. pungens* and *T. schinzii* (Pavey 2006g).

The Bilby is found in a fairly wide range of habitats including stony uplands, lateritic areas, hummock grassland sand plains, mulga scrub and woodlands, drainage depressions and palaeodrainage systems (Southgate 1990). They seem to be strongly associated with lateritic and some other stony areas with sandy soils (containing stone fragments) deep enough to allow burrows to be constructed, and often associated with palaeodrainage areas (Southgate 1987). Southgate (1990) identified three major vegetation types where Greater Bilby occurs:

- Open tussock grassland (both grasses and forbs) growing on uplands and hills.
- Mulga woodland/shrubland (both pure mulga and mixed stands of mulga/witchetty bush) growing on ridges and rises.
- Hummock grassland growing on sand plains and dunes, drainage systems, salt lake systems and other alluvial areas.

The Bilby tends to avoid densely vegetated areas. A patchwork of different post-fire ages of vegetation is preferred. Fire seems to maintain the sparse vegetation they prefer, and promotes the ephemeral plants used as secondary and primary food sources (Johnson 1989). The Bilby is not a sedentary species, moving over a wide area according to changing food and vegetation cover conditions (associated with seasons and fires) (Johnson 1989).

Surveys in the Tanami Desert indicate that bilbies are most likely to be found in the Granites-Rabbit Flat region and west of Tennant Creek (Pavey 2006g). Greater Bilby surveys in the NT in the 1990s indicated that laterite and drainage line land units were occupied more frequently than sand plain and dune systems (Southgate et al 2005). However, when resources are plentiful they will forage in variety of habitat types.

The Greater Bilby has an opportunistic foraging strategy and feeds on a wide range of plant and animal taxa with major dietary components varying across seasons and geographic range (Pavey 2006g). Most food is excavated from the soil and holes can be 250mm in depth. In the Tanami Desert, seed and bulb plant foods are a major component of the diet, in particular the seed of *Yakirra australiense* and bulb form *Cyperus bulbosus*, and invertebrates are relied upon when plant food is scarce (Southgate & Carthew 2006).

In captivity the life expectancy of Greater Bilby regularly exceeds five years and has been recorded exceeding 10 years. A captive breeding colony of 19 individual was found to have an average life expectancy of four years (Southgate et al 2000). Bilbies can breed throughout the year (Pavey 2006g) with litter sizes typically two young and occasionally one or three (Southgate 1987). In good conditions there is potential for four litters to be produced within a year (Southgate 1987).

Greater Bilbies aggregate in relatively high densities in areas where favoured plant food becomes abundant and easy to obtain. The Greater Bilby can reach a density of 12-16 individuals/km² in optimal habitat; however, a density of 1-2/km² is considered more typical (Pavey 2006g). Bilbies are known to periodically

vacate an area for a new location, usually in response to depleted food resources. The nomadic nature of the species enables it to respond to patchy and uneven food availability (SKM 2012).

The Greater Bilby is not sedentary and an occupied area will be periodically vacated for a new location (Southgate 1987). Depleted food resources are the probable stimulus that results in a Bilby vacating an area (Southgate 1987). This itinerant nature of the Bilby enables it to respond to patchy and uneven food availability (Southgate 1987).

Bilbies live in deep burrows excavated in sand that are 2 to 3 meters long, and 100 to 150 mm in diameter. The entrance is usually against a bush or surface irregularity, although they may be dug in flat, featureless locations (Johnson 1989) (as is the case for some observed in the Twin Bonanza region). Bilbies appear to vacate burrows and reuse old burrows over time. A number of burrows, from a few up to more than 100 in an area several kilometres square (Southgate 1987; Johnson 1989) may be occupied by a number of animals at one time, colonies may be vacated and reused frequently and opportunistically, and the long-term seasonal home range of a group of Bilbies may be large (up to hundreds of square kilometres) (Southgate 1987). An individual may have over a dozen regularly used burrows within its home range and several different burrows may be visited in a single night (SKM 2012; Pavey 2006g). On consecutive nights, only from 2% to 27% of burrows have been observed to be used, and 14 of 35 burrows were not used on any one night. Some burrows appeared to be used regularly, while others were used only infrequently or transiently (Johnson 1989). Foraging distance from a burrow ranges from 200 to 600 m. Research is continuing on this species.

Distribution – Southgate (1987) has found that it is widespread but in relatively low numbers throughout the Tanami Desert, although no specific studies have been undertaken in the areas considered here for proposed developments (apart from recent efforts discussed in this report).

Historically the Greater Bilby occupied a substantial area of arid and semi-arid Australia. Its range and population declined dramatically following European settlement and it currently occurs across about 20% of its former range (Southgate 1990). The species now occurs in two distinct geographic areas, one of which extends from the desert region of the Northern Territory and Western Australia north to the Pilbara and Kimberley regions. The Tanami Desert is considered as containing critical habitat for the species (Pavey 2006g).

Threatening Processes – Predation by European Fox (*Vulpes vulpes*) is a major threat to the Greater Bilby in the Northern Territory while feral cat (*Felis catus*) and Dingo (*Canis lupus dingo*) also predate on the species. There is considerable interaction between these species, as Dingoes may protect the Greater Bilby by restricting Fox and Cat populations (Pavey 2006g).

Competition with rabbits (*Oryctolagus cuniculus*) is an additional threatening process faced by the Greater Bilby, though rabbits are unlikely to occur in the northern Tanami Desert. The increase in One-humped Camel (*Camelus dromedaries*) numbers in western NT is also a potential threat to populations of the Greater Bilby. The large size of camels (up to 1000kg) combine their preference for dune systems and their tendency to consume a large portion of available plant species suggest that the species poses a significant threat to Greater Bilby habitat (Pavey 2006g).

Bilbies and Mining – The greatest direct impact of mining operations is the destruction and degradation of Greater Bilby habitat (Pavey 2006g). The location of mines adjacent to palaeodrainage channels, which appear to be favoured Bilby habitat, may have long term impact to the species at a regional level. The positioning of tailings dams on laterite substrates could deleteriously impact Bilbies and other threatened marsupials (Pavey 2006g).

Internal mine roads have the potential to cause Greater Bilby mortality at a local level if they are used at night. Collisions with vehicles on haul roads at night have been a cause of Bilby mortality in the Tanami Desert (Pavey 2006g).









Response to Fire – Changes in the pattern of fire regimes following European settlement has been hypothesised as a factor behind historic Greater Bilby decline, combined with the introduction of exotic

predators (Southgate et al 1994). Fire temporarily modifies vegetation cover which may facilitate the presence of exotic predators within Bilby habitat. High intensity uncontrolled fires are of particular concern; however, a link between specific fire histories and Bilby abundance has yet to be established (Pavey 2006g).

Due to their burrowing abilities the Greater Bilby is not reliant on vegetation for shelter thus enabling the species to persist in recently burnt and sparsely vegetated areas. In the Tanami Desert, Bilbies are known to be reasonably tolerant of fire, being able to inhabit both recently burnt and long unburnt sites. Studies within the region have demonstrated that fire-promoted plants constitute an important component of Bilby diet in recently burnt areas, with termites and other invertebrates increasing in dietary composition when bulb foods become less readily available (Southgate & Carthew 2006).

Heterogeneity of fire intervals and size of patch burns are highest in the mid-latitudes of the Tanami desert, coinciding with highest prevalence of Greater Bilby. Proximity to recently burnt habitat has been found to correlate significantly with Bilby occurrence in the Tanami, where fire-promoted vegetation is also relatively heterogeneous. Fire and the promotion of key food plants are therefore likely to be an important determinant of Bilby distribution (Southgate & Carthew 2006).

Table 7. Photos of Bilby sightings, signs and typical habitat within the Twin Bonanza Project Area.

<p>Sightings</p>		
<p>Camera trap image of Bilby using burrow near VS1E</p>		<p>Bilby seen during nocturnal searches in 2012 (GHD 2012)</p>
<p>Typical habitat</p>		
<p>Typical Bilby habitat – open spinifex grassland on lateritic sand plain. Left – CS5, Right VS1E</p>		
<p>Burrows</p>		
<p>Bilby Burrows found within the Twin Bonanza Project Area.</p>		
<p>Tracks and diggings</p>		
<p>Signs of fresh Bilby activity. Left – forage digging. Right – track.</p>		

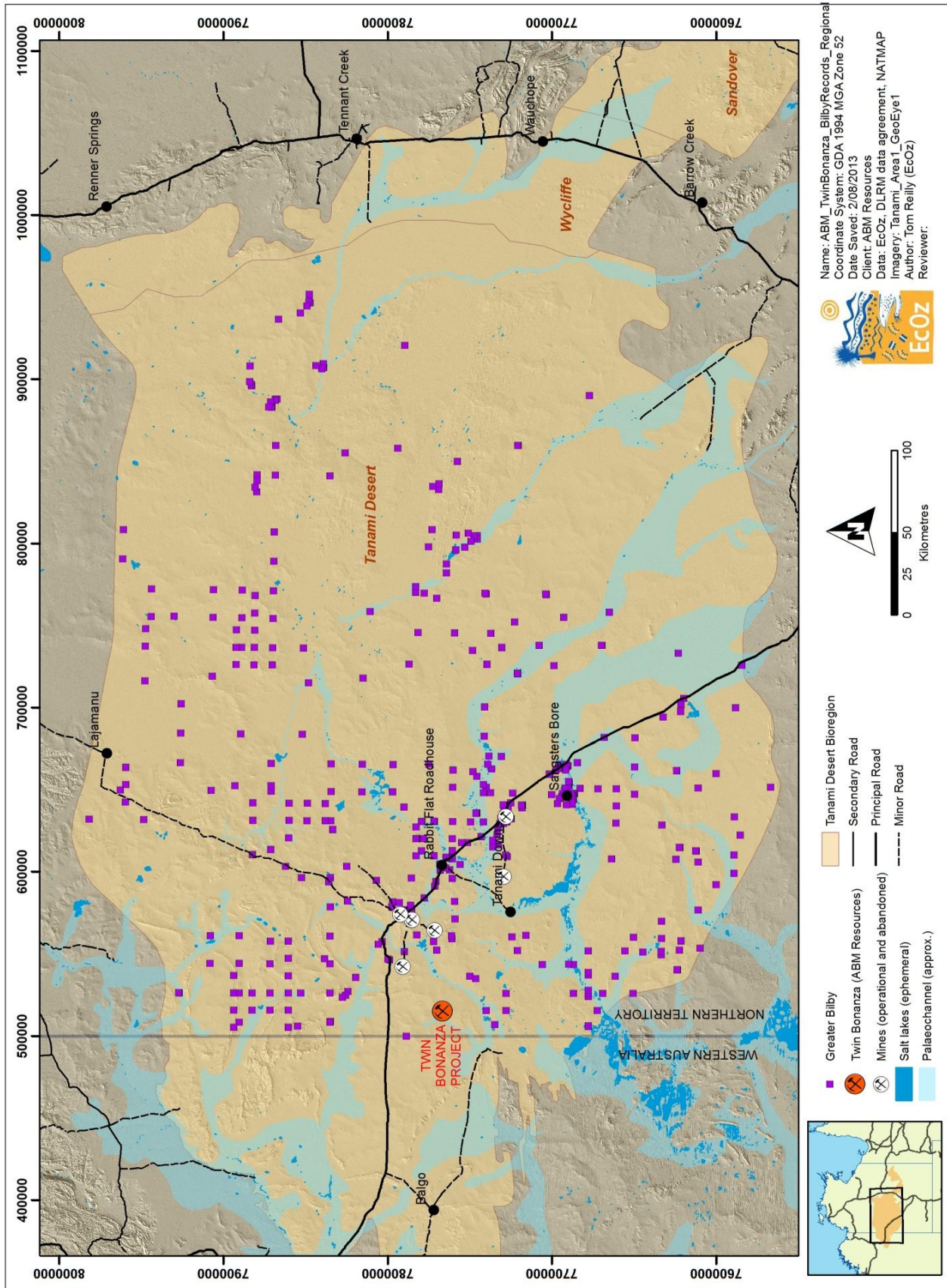


Figure 20. Bilby records in the local area around Twin Bonanza.

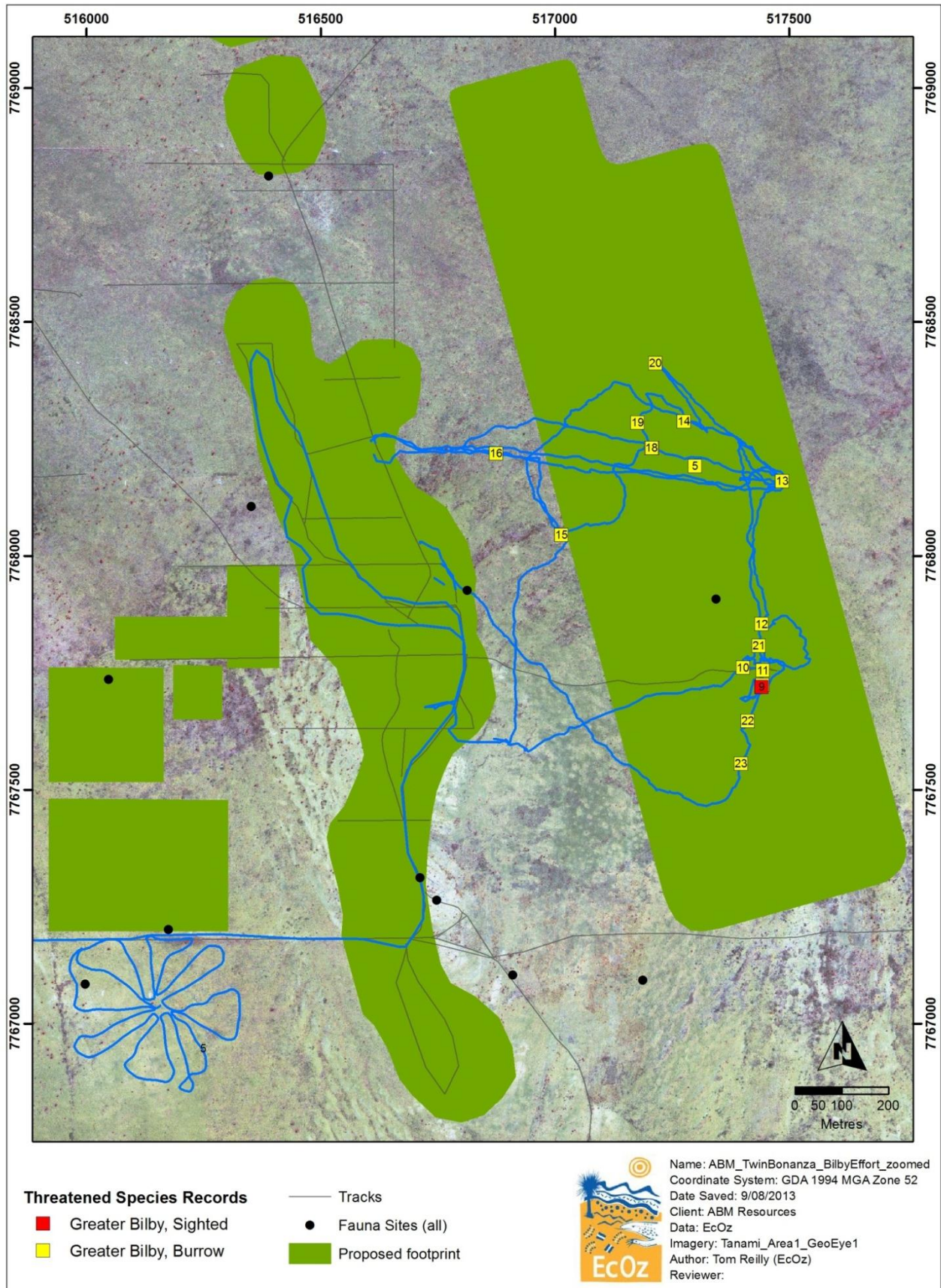


Figure 21. Bilby reported sightings within Twin Bonanza proposed footprint.

Great Desert Skink (*Liopholis kintorei*)

Presence at Twin Bonanza – The Great Desert Skink was not recorded during any of the previous surveys at Twin Bonanza. A population of the species occurs approximately 100 km to the east and south-east of the project area (see Figure 22). Therefore, it may be possible that this species could be present within the project area, however survey evidence to date has not identified any burrows of this species (which are very conspicuous due to an obvious latrine).

Description – The Great Desert Skink is a large smooth-scaled lizard with an average snout-vent length of 200 mm (maximum of 440 mm) and a body mass of up to 350 g (Pavey 2006f). The head is blunt and the tail is slightly longer than the snout-vent length. Adult males often have blue-grey flanks while females and juveniles are a rich reddish brown above with brown edge scales forming narrow longitudinal lines (Pavey 2006f).

Ecology – The Great Desert Skink is an omnivore that feeds on a variety of invertebrates (particularly termites), small vertebrates and the fruits, leaves and flowers of plants (Pavey 2006f). The species generally occurs on red sand plains and sand ridges with hummock grassland and scattered shrubs. In the Tanami Desert it is known to occupy palaeochannels on lateritic soils supporting *Melaleuca* shrubs (SEWPAC 2013).

Great Desert Skinks excavates large complex burrow systems up to 13 m in diameter, with as many as 20 entrances (McAlpin et al. 2011). Families share a single burrow as well as a defecation site (latrine) at the surface of an occupied burrow (Pearson et al 2001; Pavey 2006f). The species is a livebearer that gives birth to 1-5 young between December and February (Pavey 2006f).

Distribution – The Great Desert Skink is endemic to the Australian arid zone. Most recent records in the NT are from the western deserts, from Uluru- Kata Tjuta National Park north to Rabbit Flat in the Tanami Desert. Populations in these areas are a stronghold for the species (Pavey, 2006f).

The Great Desert Skink Tanami population Outside of the NT the species occurs in the Gibson Desert in north-west South Australia and the southern sections of the Great Sandy Desert of Western Australia (Pavey, 2006f).

Threatening Processes – Large intense wildfires pose a significant threat to the Great Desert Skink. Fire regimes in the western deserts have changed following the cessation of traditional of traditional patch management burning. Large areas now remain unburnt for years and when fire does occur it is usually very hot and extensive, leaving few patches of unburnt habitat remaining (SEWPAC 2013).

European Red Fox (*Vulpes vulpes*), Feral Cat (*Felis catus*) and Dingo (*Canis lupus dingo*) are predators of the Great Desert Skink. Birds of prey also pose a threat, particularly in recently burnt habitat with limited cover (Pavey 2006f).

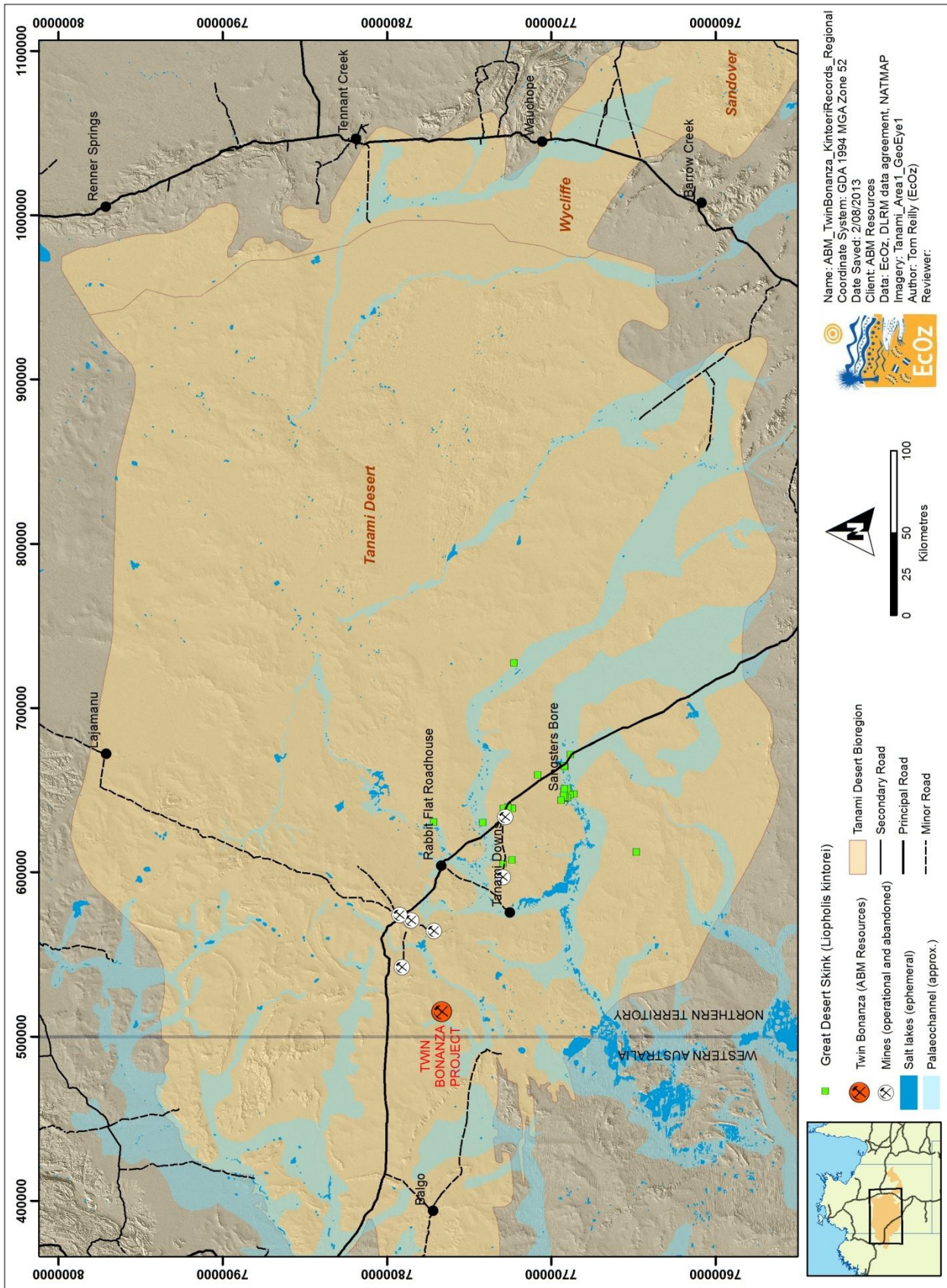


Figure 22. Great Desert Skink records in the local area around Twin Bonanza

5.4.6 Introduced/Pest Fauna

Two introduced species were recorded during the fauna survey:

- Feral Cat (*Felis catus*)
- One-humped Came (*Camelus dromedaries*)

The previous fauna survey also identified the above species, but also a House Mouse (*Mus musculus*) was captured in the camp area during the September 2012 dry season survey (EcOz 2012). It is important to note that native mice species (i.e. Sandy Inland Mouse *Pseudomys hermannsburgensis*) were also captured around camp therefore it was not suggested that mouse traps or baits were set as it is often difficult to distinguish these species to an untrained eye.

These species are widespread and established in the region and are both regarded as a threatening process toward ecological biodiversity. Species descriptions are provided below.

The European Red Fox (*Vulpes vulpes*) is also discussed in this section as they are listed as a possible threat to threatened species (and other native fauna) within the region. Current survey effort has not recorded foxes within the project area. Dingoes (*Canis lupis dingo*) are also included as they are known to be pests around developments and camps within the Tanami Desert.

Feral Cat (*Felis catus*)

Presence at Twin Bonanza – Feral Cats (*Felis catus*) were recorded within the Twin Bonanza Project Area during the most recent survey and in 2012 (GHD 2012). Population numbers did not appear to be high, however it is likely that cats avoided surveyor during nocturnal activity.

Ecology and Distribution – Feral cats occur throughout the Australian mainland in a variety of different habitats including deserts, forests and grasslands. Total population estimates vary; however, a figure of 18 million was cited in the Threat Abatement Plan (DEWHA, 2008). Feral cats are predominantly solitary and nocturnal. They are carnivorous and can survive with limited access to water, relying upon moisture from their prey. Each feral cat is estimated to kill between 5-30 native wildlife per day (AWC 2012).

Impacts – Cats play a significant role in the decline of native fauna and have been recognised as contributing to the decline of several ground-nesting birds and small to medium-sized mammals in the arid zone, including the Greater Bilby (*Macrotis lagotis*). As a consequence ‘predation by feral cats’ is listed as a key threatening process under the EPBC Act and the Threat Abatement Plan for predation by feral cats (DEWHA 2008) has been developed.

Control Methods – Feral cat populations are difficult to control. The only successful eradication programs in Australia have been carried out on islands or within mainland areas enclosed by feral-proof fences (AWC 2012). The Feral Cat Abatement Plan states that ‘although total mainland eradication may be the ideal goal of a (Threat Abatement Plan), it is not feasible with current resources and techniques’ (DEWHA 2008). Techniques that have proved successful on islands and mainland enclosures, such as baiting, trapping and shooting, are less effective at a landscape scale. Cats are extremely wary and difficult to locate, making trapping and shooting resource-intensive and impractical. The removal of cats from a local area is likely to be offset by immigration from adjacent areas (AWC 2012).

The Threat Abatement Plan identifies a major obstacle to the control of feral cats as the lack of a suitable bait-toxin that is attractive to cats. Part of the difficulties lies in developing a bait that is palatable to cats and unattractive or inaccessible to non-target species such as goannas and birds (DEWHA 2008).

Evidence suggests that Dingoes (*Canis lupus dingo*) may restrict feral cat numbers by both direct predation and competition. The presence of Dingoes within an area is likely to suppress the density of feral cats. The maintenance of a stable Dingo population may play a significant role in limiting the impact of feral cats on native animals such as the Greater Bilby (AWC 2012). The presence of Greater Bilby within the project area may owe to the presence of a healthy population of Dingo.

Recommended Management – As Feral Cats are known to occur within the project area, there will be a requirement for ABM to ensure that populations are “at least” not increased due to the presence of the mining operations. This will require management decisions in relation to land fill design, water source minimisation, and camp design (i.e. they may live and/or shelter under dongas during the day). ABM may also choose to further reduce chance of population spike by conducting a localised trapping program around potential attraction sources (i.e. land fill) and also supplement that with periodic culling by professional hunters and Traditional Owners. This will be favourable to all native species in the local area due to reduced predation pressure.

One-humped Camel (*Camelus dromedaries*)

Presence at Twin Bonanza – Feral Camels (*Camelus dromedaries*) were not observed in the project area; however, fresh camel tracks were recorded in the Old Pirate and Buccaneer prospects.

Ecology and Distribution – The estimated population of camels in Australia is approximately one million at an overall density of 0.29/km² (Edwards et al 2008). Camels are capable of using almost all available habitat types within the arid and semi-arid areas of Australia (SEWPAC 2010). They have the ability to move over areas of thousands to tens of thousands of square kilometres. Edwards et al (2001) found that camels in the northern Tanami Desert use an area of approximately 450 km².

Camels use almost all food sources available to them within their habitat; however, the majority of their food intake is limited to a small suite of species. The conservation status of three plant species, *Erythrina vespertilio*, *Acacia sessiliceps*, and *Santalum acuminatum*, have been identified as being impacted by camel browsing (Dörge and Heucke 2003). All of which have not been recorded in the Tanami bioregion (according to DLRM records held in the NT Atlas).

Impacts – Negative environmental impacts from Feral Camels include damage to vegetation through foraging behaviour and trampling, suppression of recruitment of some plant species, and competition with native animals for food and shelter (Edwards et al 2008). The increase in One-humped Camel (*Camelus dromedaries*) numbers in western NT is also a potential threat to populations of the Greater Bilby. The large size of camels (up to 1000 kg) combine their preference for dune systems and their tendency to consume a large portion of available plant species suggest that the species poses a significant threat to Greater Bilby habitat (Pavey 2006g).

Camels are also known to negatively impact on wetlands through fouling trampling and sedimentation. They not only damage the ecology and hydrology of wetlands but remove free-standing water and even impair the ability of some wetland types to hold water (Edwards et al 2008).

Recommended Management – No specific management measure are justified for this project. Feral camels do not pose a threat to conservation significant flora and fauna within the ABM project area due to suspected low population counts and limited water supply points (i.e. salt lakes).

European Red Fox (*Vulpes vulpes*)

Presence at Twin Bonanza – European Red Fox (*Vulpes vulpes*) was not observed in the project area. The species was not recorded during the two previous fauna surveys in the project area. Twin Bonanza is north of foxes currently known distribution; therefore it is unlikely that established populations occur in the region of the project. However, records of foxes should be immediately reported to the Northern Territory Government (DLRM) as they will likely be the northern most records for this part of the Tanami Desert.

Ecology and Distribution – The fox was introduced into southern Australia in 1855 and has since spread across much of the mainland, following the spread of its favourite prey, the rabbit (*Oryctolagus cuniculus*) (SEWPAC 2010; DPI NSW 2012). The species distribution may still be expanding northwards, having reached the Tanami Desert in the 1970's and becoming relatively common as far north as Tennant Creek.

Foxes are absent from the tropical climates of northern Australia with heat and humidity being a limiting factor for the species (DPI NSW 2012).

The European Red fox is a primarily nocturnal hunter, being most active in the evenings and early mornings. During the day the fox sleeps in dens, logs and other shelter. The fox eats almost anything, preying and scavenging on all available food resources. Its main food source is small animals weighing between 35-500 g, including mammals, reptiles and ground nesting birds (DPI Victoria 2013a).

Fox territories range from 2 to 5 km² depending on habitat type and availability of food. Individuals usually move within their own territory but may travel up to 25 km when food is scarce. Male and female foxes are sexually mature at one year and produce an average litter of four cubs. The breeding season is August to September (DPI NSW 2012).

Impacts – The European Red fox is of significant conservation treat to Australian Wildlife (Parks and Wildlife Commission 2012). Predation by the European red fox is listed as a key threatening process under the Commonwealth EPBC Act 1999. The species is understood to be a threat to many species of native wildlife including Black-footed Rock-wallabies (*Petrogale lateralis*), Brush-tailed Bettong (*Bettongia penicillata*), Numbats (*Myrmecobius fasciatus*), Tammar wallabies (*Macropus eugenii*) and Malleefowl (*Leipoa ocellata*) to name a few. In the Northern Territory, one of the two last known wild populations of the Rufous Hare-Wallaby (*Lagorchestes hirsutus*) was exterminated by a single fox (Parks and Wildlife Commission 2012). Remaining wild populations of the Bilby (*Macrotis lagotis*) may be at risk of extinction if fox numbers in Northern Australia continue to rise (Parks and Wildlife Commission 2012).

European Red Fox may pose a threat to conservation significant fauna in the ABM project area. Control methods for foxes include baiting, shooting, trapping, den fumigation or destruction, and exclusion fencing. Apart from broad scale baiting, the methods are expensive, labour intensive, long term and of limited effectiveness. Individual identification of foxes by scat genotyping has potential for monitoring abundance before and after control programs (DEWHA 2008).

Recommended Management – No specific management measure are suggested for the Twin Bonanza project as our research has identified little evidence that they occur in the local area. Therefore, recommended management of this species is targeted towards notification of sightings (or potential sightings). If foxes are identified on the project area, ABM should report the record to DLRM and discuss possible actions. Additionally, other management measures that will be applied for Feral Cats, Wild Dogs, and Dingoes will also be relevant to Foxes.

Dingo (*Canis lupis dingo*)

Presence at Twin Bonanza – Dingo (*Canis lupus dingo*) was recorded at the Old Pirate prospect during the most recent survey, and was recorded in the project area during the two previous surveys.

Ecology and Distribution – The Dingo originated in southern Asia and arrived in Australia approximately 4000 years ago. At the time of European settlement Dingoes occurred throughout the mainland, though numbers were thought to have been low. Domestic dogs arrived with European settlers and hybridization between the two sub-species has led to a smaller proportion of pure dingoes in Australia (Major 2009). Today Dingos and their hybrids occur throughout most of the Australian mainland, with small areas of absence in southern Australia. A photo of a dingo observed at Twin Bonanza is provided in Appendix I.

Dingoes are opportunistic hunters, eating almost anything they can overcome and kill. They prey on native species such as kangaroos, bandicoots and wombats as well as introduced species such as rabbit, sheep, goats and pigs. Animals can hunt alone as well as cooperatively in packs to bring down larger animals. Dingoes usually concentrate on the most abundant prey available before switching to the next most common prey as their previous prey declines (Greer 2009). They are efficient scavengers, feeding on carrion and human waste when prey numbers are low, and also eat fruit and flowers. Such a flexible diet serves the species well in the variable Australian climate (Greer 2009).

Dingos breed once per year, usually during April to June (EEDI 2010). A typical litter is 4-6 pups, which remain dependant on the adults for 6-8 months. In packs a dominant breeding female will kill the offspring of other females (National Geographic 2013). Home ranges vary according to the productivity of the country, from 300 km² in the Nullarbor Plain to 9 km² in rainforest areas (EEDI 2010).

Impacts – Recent evidence indicates that Dingos perform an important ecological function in maintaining species diversity in some ecosystems (Major 2009). Following the extinction of the Thylacine (*Thylacinus cynocephalus*), Dingoes have become the top mammal predator of the Australian landscape. As apex predators they regulate the numbers of smaller predators and generalist herbivores, thus alleviating the pressure that these groups exert on their own prey and competitors and on the vegetation (Greer 2009). Some research has indicated that they protect native species numbers by controlling densities of foxes, cats and goats (Major 2009).

The extent to which feral dogs and hybrids have replaced Dingo's as apex predators is uncertain (Major 2009). Predation by wild dogs can impact on remnant populations of threatened species, with endangered species with small populations being particularly vulnerable. The Dingo has long been regarded as a serious predator of domestic stock and wild dogs impact farming communities in a similar manner (DPI Victoria, 2013b).

Dingoes and wild dogs may pose a threat to threatened species in the ABM project area. Control methods for Dingoes and feral dogs vary from baiting trapping, shooting and exclusion fencing. Care must be taken in regards to baiting and trapping as potential exists for harm non target native species (DPI Victoria 2013b). Remote sensing is a useful tool to determine the presence, identity, number and activity patterns of suspected dingoes and wild dogs. Information from monitoring can be used to determine baiting rates, the number of traps required and the suitability of trap or bait sites (DPI Victoria 2013c). The main bait used for wild dogs is 1080, which requires a '1080 Pest Animal Management Authorisation' permit as well as a 'Permit to take protected wildlife' in the Northern Territory, and includes the permit for the purpose of taking dingoes (DPIF 2013).

Recommended Management - For the Twin Bonanza project, we suggest that management is targeted towards "not increasing local dingo populations". This is important because increased dingo populations (as mining often increases available food, water, shelter, and also provides soil piles for making breeding dens) will apply more pressure on other native species (i.e. Greater Bilby), and also resulted in resource stressed populations once mining ceases and associated resources are not available (which may lead to unethical mortalities and increased predation pressure on other native species).

House Mouse (*Mus musculus*)

Presence at Twin Bonanza – House Mouse was recorded at Wilsons Camp during the October 2012 survey, but was not recorded during the most recent survey or April 2012 surveys. None were trapped or observed away from the camp site.

Ecology and Distribution – In Australia the House Mouse can be found wherever people occur as well as several areas where they do not. The species has adapted to a wide variety of habitats including deserts, tropical and alpine areas as well as in cities, towns and wilderness (DPI Victoria 2010). The house mouse is widespread in the Northern Territory (LRM 2012).

House mice breed throughout the year, though there is a pronounced burst of breeding activity in spring-early summer. Mice generally do not breed in winter. House mice litters vary between 4 and 8 offspring, though larger litters have been recorded. Sexual maturity is reached at about eight weeks of age (DPI Victoria 2010).

Mouse plagues occur where quality food and water is readily available, environmental temperatures are not extreme, nesting conditions are favourable (moist soil) and predation levels are low (DPI NSW 2011). In Australia such plagues are limited to the southern and eastern grain belts of Australia (CSIRO 2003).

Impacts – The House Mouse is not considered to be a great threat to biodiversity. There have been some concerns about their impact to native vegetation due to seed predation and in some areas they are known to prey on small birds (LRM 2012).

House mice can be of nuisance in urban areas because they spoil food and food packaging, carry and spread diseases, and chew insulation, electrical wiring, vehicle parts and all manner of infrastructure (DPI Victoria 2010). It is likely that this will be the main issue concerning house mice at Twin Bonanza.

Recommended Management – Before committing resources to mouse control it is important to confirm mouse numbers present warrant the control cost. House mouse can be detected on roads at night, via spotlight monitoring or activity around buildings, however there are native species that appear very similar to house mice if not identified “in hand”. The use of poisonous bait around buildings and storage facilities may be relatively successful for controlling small populations of mice (DPI NSW 2011). However, rodenticides are potentially dangerous to native animals and humans if misused and should only be applied in the instance of higher than normal populations (DPI Victoria 2010). One potential option is to conduct a live trapping exercise (using Elliott traps) and dispose of mice once identification is confirmed.

House Mouse can be difficult to keep out of buildings due to their ability to swim, dig, jump up to at least 300 mm, jump down at least 2.5 m without injury, and squeeze through small openings (DPI Victoria 2010). If House Mouse occurs around living quarters and infrastructure the following mitigation methods should be considered (LRM 2012):

- Remove access to all food sources.
- Dispose of garbage away from urban living quarters.
- Remove any animal or pet foods that might be openly available.
- Mouse-proof any food storage areas or containers.

6 Conclusion

6.1 Biological Survey Effort at Twin Bonanza

There have been three comprehensive biological surveys within the Twin Bonanza project area (listed below), which has provided a suitable baseline dataset for ecological risk assessment of the proposed mining operations. The survey effort listed below has been illustrated in Figure 23:

- Flora, Fauna, Vegetation Mapping Surveys, April 2012 (GHD 2012).
- Fauna Surveys, September 2012 (EcOz 2012).
- Flora, Fauna, Vegetation Mapping Surveys, May 2013 (this report).

Other ecological based surveys that have occurred within the project area include:

- Weed surveys of the Old Pirate prospect, April 2012 (GHD 2012).
- Brush-tailed Mulgara and Greater Bilby Pre-clearance surveys for the infrastructure area associated with the Twin Bonanza Bulk Sampling Project, May 2013 (EcOz 2013)
- Weed surveys of the Twin Bonanza Project Area, May 2013 (EcOz 2013).
- Greater Bilby survey transects and camera surveillance within the Twin Bonanza project area (and surrounds), ongoing project conducted by ABM Resources Environment Manager.

6.2 Flora Summary

The combined flora survey results for the project area generated a total of 180 species (Appendix G), of which none were threatened under Northern Territory or Commonwealth legislation.

The desktop assessment indicated that it was unlikely that threatened flora species would be supported in habitat types within the project area. There were several data deficient and not evaluated records identified during the surveys which have been submitted as voucher specimens to the Northern Territory herbarium (in Darwin).

Two flora species (*Acacia abbreviata* and *A. minutifolia*) endemic to the Tanami Desert were recorded and two species are of regional significance due to their restricted ranges in the Northern Territory (*Dampiera candidans* and *Sclerolaena muelleri*).

Five vegetation types were described within the project area (see Section 5.3.3), including:

- Vegetation type 1: Low *Eucalyptus brevifolia* isolated trees ± mid high *Acacia lysiphloia* or low *A. hilliana* isolated shrubs over *Triodia basedowii* open hummock grassland. Occurs on rocky outcropping.
- Vegetation type 2: *Triodia basedowii* and *T. intermedia* mid open hummock grassland with *Acacia minutifolia* and *A. adoxa* var. *adoxo* low open shrubland. Occurs on gravel flat to gentle relief.
- Vegetation type 3: Open *Triodia* spp. Hummock grassland ± low *Eucalyptus brevifolia* or *Hakea lorea* isolated trees with tall ± *Grevillea wickhamii* or *Acacia* spp. Open shrubland. Occurs in sand plains.
- Vegetation type 4: Low *Corymbia opaca* or *Eucalyptus victrix* ± *Eucalyptus brevifolia* open woodland with tall *Acacia sericophylla* open shrubland over *Triodia pungens* open hummock grassland. Occurs in Palaeochannels.
- Vegetation type 5: *Acacia aneura* woodland over mixed tussock grass. Occurs within a variety of landform, however always present on heavy soils with high clay content.

No threatened ecological communities were identified by desktop review or on ground studies.

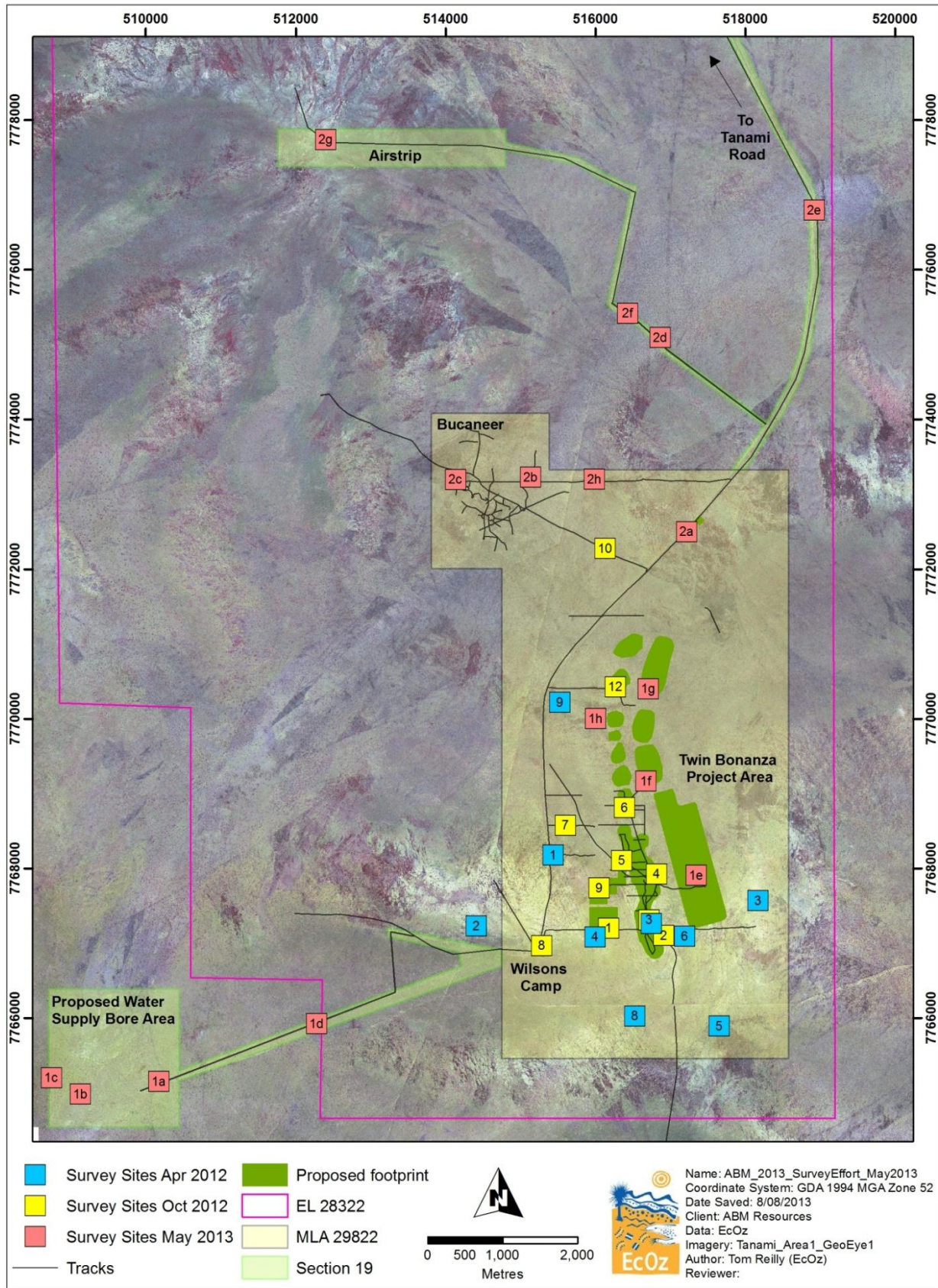


Figure 23. Current Biological Survey Effort within the Twin Bonanza Project Area (All)

The palaeochannel land unit was highlighted as a sensitive habitat type, as palaeochannels in the Tanami Desert are known to support a high level of biodiversity (including threatened species refuge).

There are currently three known weed infestations within the project area, which are all Buffel Grass (*Cenchrus ciliaris*) infestations (see Section 5.3.5). These include:

- Wilsons Camp (initial control methods have already been conducted).
- Wilsons Bore (initial control methods have already been conducted).
- Junction of Tanami Road/Wilsons Camp Access Track.

All infestations are currently minor and need to be managed prior to mining operations, as they will provide a weed source and increase risk of weed spread in the region. Small Buffel Grass infestations, such as the ones that exist at Twin Bonanza, can be easily eradicated if well-structured weed management procedures are followed. These methods should be detailed in a site specific Weed Management Plan.

6.3 Fauna Summary

The combined fauna survey results for the project area generated a total of 24 species (Appendix B), including 30 reptiles, 58 birds, and 24 mammals. No amphibians were recorded. Two of these species were threatened under Northern Territory and/or Commonwealth legislation, these included:

- Brush-tailed Mulgara (*Dasymercus blythi*) – Vulnerable under the TPWC Act.
- Greater Bilby (*Macrotis lagotis*) – Vulnerable under the TPWC Act and EPBC Act.

The desktop assessment indicated that 11 threatened fauna species could be supported in habitat types within the project area (see Section 3.4). Therefore, these species will be part of the risk assessment process associated with the project's EIS. This aims to ensure that risk is appropriately mitigated for each of these species.

Three introduced fauna species were confirmed to be present within the project area, including the Feral Cat (*Felis catus*), One-humped Camel (*Camelus dromedaries*), and House Mouse (*Mus musculus*). There are several other introduced species that are likely to be present within the region (see Section 5.4.6).

6.4 Management strategies to minimise impact on threatened species

A range of options are available to reduce (and hopefully negate) impact on the two threatened species confirmed to occur in proposed development zones. Potential options are listed below and will be expanded upon in the EIS for the Twin Bonanza Project.

- Speed restrictions within the project area (especially at night) to reduce chance of road kill.
- Inclusion of threatened species information in site inductions.
- Utilise existing suitable habitat mapping, identifications, and burrow surveys (from this report and the threatened species database developed as part of this report) to adjust final mining footprint to reduce impact on threatened species.
- Conduct detailed pre-clearance surveys prior to any land disturbance. These surveys will locate active and inactive burrows, and provide a map to the mining company that illustrates current activity within the clearing footprint. Then a decision can be made in regards to actual direct impact to these species. Pre-clearance survey protocols should be clearly described in the EIA. Ideally, these surveys should be conducted after a prescribed burn of the plot.
- If threatened species activity is detected within an area proposed for land clearing, this will trigger a decision making process that aims to ensure that burrows in the clearing zone do not contain Greater Bilby or Brush-tailed Mulgara. These details will be developed in the Biodiversity Management Plan for the project, but thoughts are suggested below:

- If active Greater Bilby burrows are encountered, an attempt will be made to displace them from the burrows followed by demolition of burrow to inhibit re-entrance. Trap and release of individuals is possible, however trapping this species is complicated as the species is known to be reluctant to enter free standing baited traps (SKM 2012). Release point and protocol would also need to be carefully planned and appropriate trapping permits gained.

Camera traps and camera probes will be used to inspect burrows to investigate current activity.
 - If active Brush-tailed Mulgara burrows are located, an attempt to capture individuals could occur by a two night Elliott trapping program. Trapped animals would then be released (at night) adjacent to the cleared area.
- Look into the feasibility of land clearing at night. This assumes that threatened species are foraging away from burrows and will not be in burrows during land clearing operations (as they will flee from the area). There also needs to be confirmation that no juvenile animals are in burrows. This option will be researched during the EIA process to improve our assumptions.
 - Both Greater Bilby and Brush-tailed Mulgara have demonstrated a capacity to persist in fire-impacted habitats. Nevertheless studies have suggested that a fire-predator interaction in Spinifex habitat occurs for both species. Despite the nature of this interaction being unclear it appears that both species are more abundant in areas where fire impacts are minimal. Optimal fire management strategy would be to prevent high intensity fires and, in areas recently impacted by fire, undertake additional exotic predator controls such as trapping, baiting and shooting of feral cats and foxes
 - Implement a feral animal control program for the project area and immediate surrounds. This would be part of the environmental offset package. Feral cats are the most prominent introduced predator in the project area, though European red fox is also likely to be present. A feral animal baiting and trapping program may be undertaken prior to relocation of Greater Bilby to improve the likelihood of successful colonisation of the area.

EcOz does not recommend a translocation program for threatened fauna species, as there is little evidence that translocations are successful and the research required to confirm success would not be within the financial scope of this project.

6.5 Environmental Offsets Opportunities

An environment offset strategy will also be required during the EIS process, especially as EPBC listed species have been confirmed to occur within the proposed mine footprint. Suggested offsets for the threatened species include:

- Feral cat control (i.e. reduce predation threat on threatened species such as Greater Bilby and Brush-tailed Mulgara – therefore protecting the local populations and offsetting habitat loss or any accidental mortalities).
- Involvement with the Tanami Desert Regional Biodiversity Monitoring Program (CLC) (Scientific Offset).
- Involvement in a Greater Bilby research program, with the purpose of publishing papers on mining impacts and management.
- Possible “funding” towards Newhaven Wildlife Sanctuary (run by Australian Wildlife Conservancy). This is located in the Tanami Desert and manages habitat that supports Greater Bilby and Brush-tailed Mulgara (plus other threatened species relevant to the project).
- Vegetation/habitat condition (i.e. fire management and rehabilitation).

Environmental offset calculations and strategies will form part of the EIS.

7 Acronyms

ABM	ABM Resources NL
ALA	Atlas of Living Australia
AWC	Australian Wildlife Conservancy
BoM	Bureau of Meteorology
CLC	Central Land Council
DEWHA	Department of the Environment Water Heritage and the Arts
DLRM	Department of Land Resource Management
EcOz	EcOz Environmental Services
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Exploration Lease
EPBC	Environment Protection and Biodiversity Conservation Act
IUCN	International Union for the Conservation of Nature
MLA	Mineral Lease Application
NRETAS	Natural Resources Environment the Arts and Sport
NTG	Northern Territory Government
NT	Northern Territory
SEWPAC	Department of the Environment, Water, Heritage and the Arts
TPWC	Territory Parks and Wildlife Conservation Act
WONS	Weed of National Significance

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Appendix A

EPBC Act Report (online access – 28/11/2012).



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

Report created: 28/11/12 10:59:09

[Summary](#)

[Details](#)

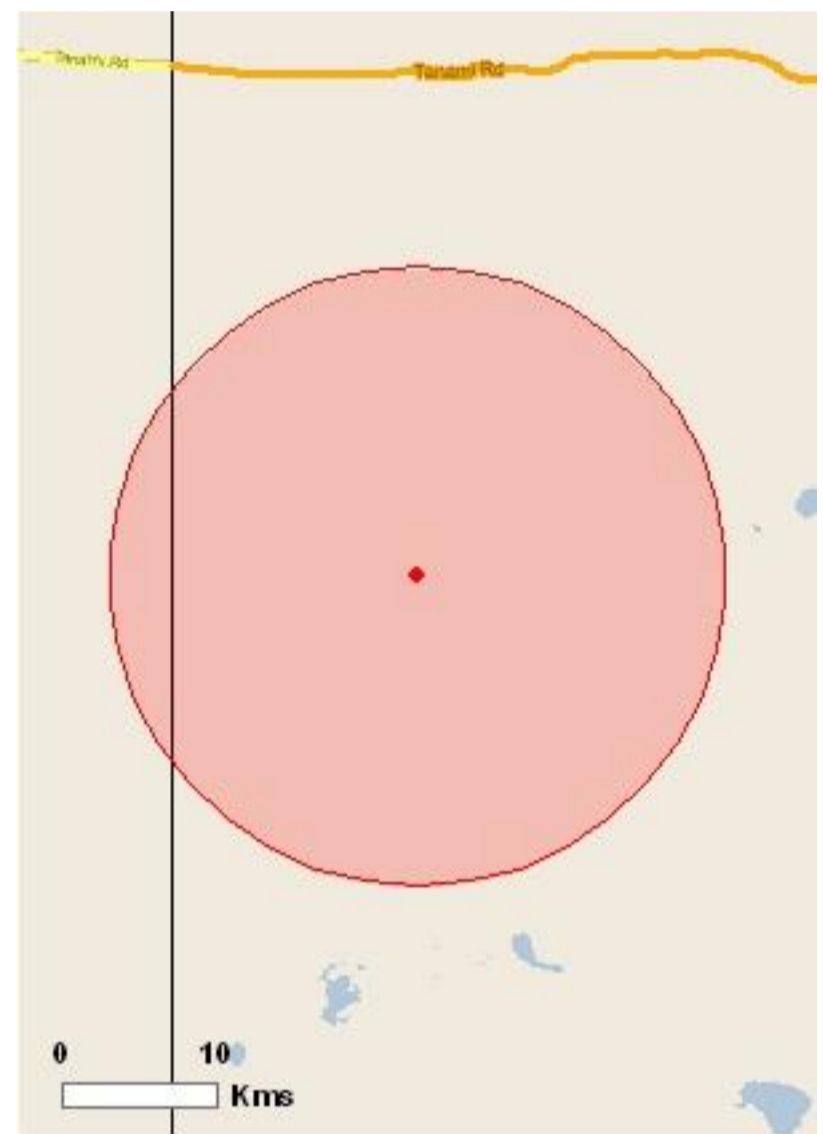
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 20.0Km



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	5
Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	4
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Rostratula australis		
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
MAMMALS		
Dasycercus cristicauda Mulgara [328]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Zyzomys pedunculatus Central Rock-rat [68]	Endangered	Species or species habitat may occur within area

REPTILES		
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area

Migratory Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

Invasive Species [\[Resource Information \]](#)

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit,

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area

Coordinates

-20.19532 129.14615

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)

- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

[Please feel free to provide feedback via the Contact Us page.](#)

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GPO Box 787

Canberra ACT 2601 Australia

+61 2 6274 1111

Appendix B

Fauna Survey Report May 2013.

Appendix B – Fauna Survey Data, May 2013

Identification Type Key: a = active search sighting; e = Elliott trap; f = funnel trap; p = pitfall trap; c = camera surveillance footage; b = bat detector (songmeter SM2+); s = signs (tracks, scats, burrows etc), X = bird record (numbers were not recorded, however notes on activity were recorded and presented in text rather than data sheets).

REPTILES		Fauna Sites																Total Records	
		Survey Period 1 (10 to 12 May 2013)								Survey Period 2 (13 to 15 May 2013)									INC
Scientific Name	Common Name	1A	1B	1C	1D	1E	1F	1G	1H	2A	2B	2C	2D	2E	2F	2G	2H		
<i>Ctenophorus isolepis</i>	Military Dragon		1a	1p, 1f, 1a	4a	1p		1a										31a	41
<i>Ctenophorus nuchalis</i>	Central Netted Dragon		1a															4a	5
<i>Ctenotus helenae</i>	Helen's Ctenotus				1a														1
<i>Ctenotus pantherinus</i>	Leopard Ctenotus	1f		1f	1f, 2a									1a				3a	9
<i>Ctenotus schomburgkii</i>	Schomburk's Ctenotus	1p, 1f, 1a			1f														4
<i>Ctenotus tanamiensis</i>	Tanami Ctenotus																1e		1
<i>Eremiascincus fasciolatus</i>	Narrow-Banded Sand Swimmer			1p														1a	2
<i>Gehyra variegata</i>	Tree Dtella	4a		2a	3a													2a	11
<i>Lucasium stenodactylum</i>	Crowned Gecko	5a				2a												4a	10
<i>Menetia greyii</i>	Grey's Menetia		1p																1
<i>Pogona minor</i>	Dwarf Bearded Dragon		2a		1a	1a													4
<i>Rhynchoedura ornata</i>	Beaked Gecko	3a	1a		2a	5a	3a	2a	1a									1a	17
<i>Strophurus ciliaris</i>	Spiny-tailed Gecko	15a	2a	3a	14a	8a	3a		3a									9a	49
<i>Suta punctata</i>	Little Spotted Snake																	1a	1
<i>Varanus acanthurus</i>	Spiny-tailed Monitor																	1a	1
<i>Varanus gouldii</i>	Sand Goanna			1s		1s		1a									1s	1a	5
Total Records		31	8	11	29	18	6	4	4	0	0	0	0	1	0	2	1	58	162
Total Species		6	6	6	8	6	2	3	2	0	0	0	0	1	0	2	1	10	16

BIRDS		Fauna Sites																Total Records	
		Survey Period 1 (10 to 12 May 2013)								Survey Period 2 (13 to 15 May 2013)									INC
		1A	1B	1C	1D	1E	1F	1G	1H	2A	2B	2C	2D	2E	2F	2G	2H		
Scientific Name	Common Name																		
<i>Accipiter fasciatus</i>	Brown Goshawk																	X	1
<i>Anthus novaeseelandiae</i>	Australasian Pipit				X														1
<i>Aquila audax</i>	Wedge-tailed Eagle																	X	1
<i>Ardeotis australis</i>	Australian Bustard		X																1
<i>Artamus cinereus</i>	Black-faced Woodswallow								X			X					X		3
<i>Barnardius zonarius</i>	Australian Ringneck																	X	1
<i>Cacomantis pallidus</i>	Pallid Cuckoo			X														X	2
<i>Circus assimilis</i>	Spotted Harrier		X																1
<i>Colluricincla harmonica</i>	Grey Shrike-thrush																	X	1
<i>Corvus bennetti</i>	Little Crow											X						X	2
<i>Corvus orru</i>	Torresian Crow																	X	1
<i>Cracticus nigrogularis</i>	Pied Butcherbird	X																	1
<i>Elanus axillaris</i>	Black-shouldered Kite																	X	2
<i>Epthianura tricolor</i>	Crimson Chat																	X	1
<i>Eremiornis carteri</i>	Spinifexbird						X												1
<i>Eurostopodus argus</i>	Spotted Nightjar		X																1
<i>Falco berigora</i>	Brown Falcon				X						X								2
<i>Falco cenchroides</i>	Nankeen Kestrel										X							X	3
<i>Falco subniger</i>	Black Falcon																	X	1
<i>Geopelia cuneata</i>	Diamond Dove																	X	1
<i>Haliastur sphenurus</i>	Whistling Kite																	X	1
<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater										X	X					X	X	4
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater																	X	1
<i>Lichenostomus virescens</i>	Singing Honeyeater								X			X							2
<i>Lophochroa leadbeateri</i>	Major Mitchell's	X										X							2

BIRDS		Fauna Sites																Total Records	
		Survey Period 1 (10 to 12 May 2013)								Survey Period 2 (13 to 15 May 2013)									INC
Scientific Name	Common Name	1A	1B	1C	1D	1E	1F	1G	1H	2A	2B	2C	2D	2E	2F	2G	2H		
	Cockatoo																		
<i>Malurus lamberti</i>	Variegated Fairy-wren				X									X					
<i>Malurus leucopterus</i>	White-winged Fairy-wren																	X	
<i>Manorina flavigula</i>	Yellow-throated Miner	X		X															
<i>Melopsittacus undulatus</i>	Budgerigar	X			X							X							
<i>Ninox novaeseelandiae</i>	Southern Boobook		X											X					
<i>Nymphicus hollandicus</i>	Cockatiel																	X	
<i>Ocyphaps lophotes</i>	Crested Pigeon			X															
<i>Oreoica gutturalis</i>	Crested Bellbird	X			X	X						X							
<i>Pachycephala rufiventris</i>	Rufous Whistler	X																	
<i>Pardalotus rubricatus</i>	Red-browed Pardalote								X										
<i>Podargus strigoides</i>	Tawny Frogmouth		X																
<i>Rhipidura leucophrys</i>	Willie Wagtail			X	X	X			X										
<i>Stipiturus ruficeps</i>	Rufous-crowned Emu-wren																	X	
<i>Taeniopygia guttata</i>	Zebra Finch			X	X	X						X							
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher			X															
<i>Turnix velox</i>	Little Button-quail											X							
Total Species		6	5	6	7	3	1	0	4	0	3	9	0	2	0	1	2	21	42

MAMMALS		Fauna Sites																Total Records	
		Survey Period 1 (10 to 12 May 2013)								Survey Period 2 (13 to 15 May 2013)									INC
Scientific Name	Common Name	1A	1B	1C	1D	1E	1F	1G	1H	2A	2B	2C	2D	2E	2F	2G	2H		
<i>Camelus dromedarius</i>	One-humped Camel		1s		1s						1s						1a		4
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			1b							1b				1b				3
<i>Dasyercus blythi</i>	Brush-tailed Mulgara						1e					1e						1s	3
<i>Macropus rufus</i>	Red Kangaroo		1s													1a			2
<i>Macrotis lagotis</i>	Greater Bilby					1c												5s	6
<i>Notomys alexis</i>	Spinifex Hopping-mouse				1p			1e		1e	5e	2e			1p, 2e	1f	1e	4a	19
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			1b	1b				1b		1b				1b				5
<i>Pseudantechinus macdonnellensis</i>	Fat-tailed Antechinus															1e			1
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	2e									3e, 1p	1e		1e	3e				11
<i>Pseudomys nanus</i>	Western Chestnut Mouse		1e							1a		1e	1e	1e					5
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat			1b	1b														2
<i>Scotorepens greyii</i>	Little Broad-nosed Bat										1b						1b		2
<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	1a	1e				1e	1p		1e	2e		2e	1f, 9e	1e	1e		1a	22
<i>Sminthopsis youngsoni</i>	Lesser Hairy-footed Dunnart					1p					1e								2
<i>Tadarida australis</i>	White-striped Free-tailed bat										1b								1
Total Records		3	4	3	4	2	2	2	1	3	17	5	3	12	9	5	2	11	87
Total Species		2	4	3	4	2	2	2	1	3	9	4	2	3	5	5	2	4	15

Appendix C

Bat Identification Report May 2013.



Bat call identification from the Tanami Desert, NT

Type: Acoustic analysis

Prepared for: EcOz Environmental Consultants

Date: 6 November 2012

Job No.: SZ287

Prepared by: Kyle Armstrong and Yuki Konishi
Specialised Zoological
ABN 92 265 437 422
Tel 0404 423 264
kyle.n.armstrong@gmail.com
<http://www.szool.com.au>

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SUMMARY

Bat identifications made from acoustic recordings are provided from the Tanami Desert, Northern Territory. One species of bat was identified as being present: Gould's wattled bat *Chalinolobus gouldii* (Table 1). The identification was unambiguous. Details supporting the identification are provided (a representative call sequence portion; Figure 1), as recommended by the Australasian Bat Society (ABS 2006). Further data are available should verification be required.

METHODS

Recordings were made with a Wildlife Acoustics Song Meter SM2BAT bat detector set to record full spectrum signals in WAC0 format; trigger 6 dB above background; 48 dB gain; and set to turn on automatically at sunset and off at sunrise. For analysis, WAC0 format files were converted to WAV format files in Kaleidoscope version 0.1.8, and then each WAV file was opened and inspected in Cool Edit 2000 software. Species were identified based on information in Churchill (2008), and nomenclature follows Armstrong and Reardon (2006).

REFERENCES

- ABS (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australasian Bat Society Newsletter* 27: 6–9. [ISSN 1448-5877]
- Armstrong, K. and Reardon, T. (2006). Standardising common names of bats in Australia. *The Australasian Bat Society Newsletter* 26: 37–42.
- Churchill, S.K. (2008). *Australian bats*. 2nd ed. Allen and Unwin, Crows Nest, NSW.

TABLE 1. Species identifications, with the degree of confidence indicated by a code. Date and unit serial number correlates with site.

	<i>C. gouldii</i>
Date	
Serial 4185	
26/09/2012	◆
27/09/2012	◆
Serial 4186	
26/09/2012	—
27/09/2012	—

Definition of confidence level codes:

— Not detected.

◆ Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. If this is a species of conservation significance, further survey work might be required to confirm the record.

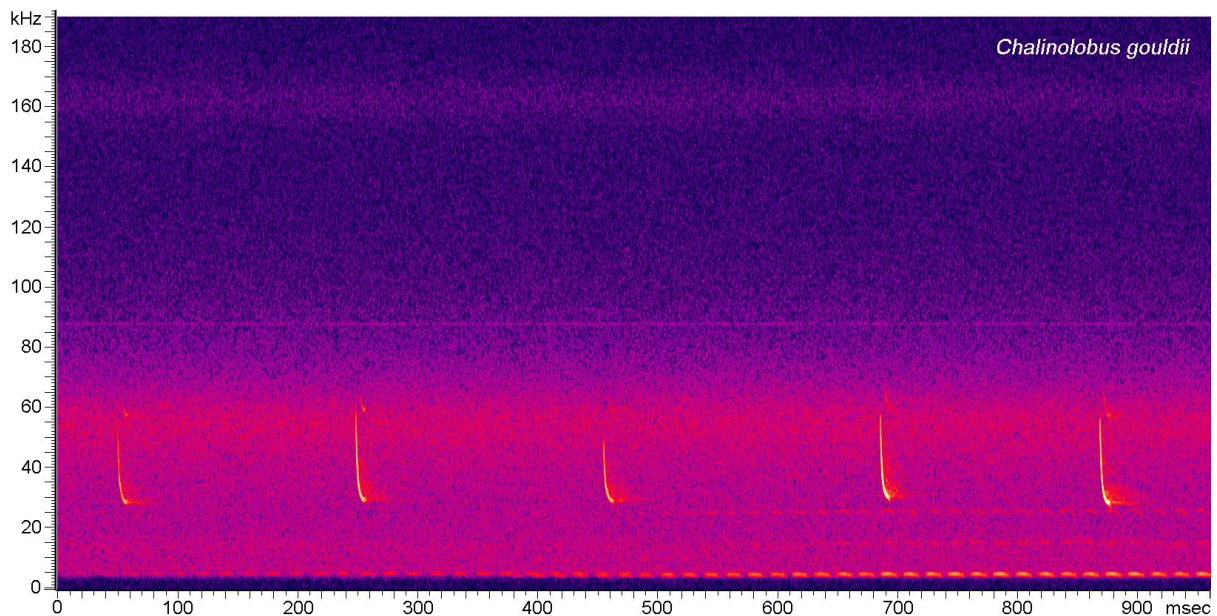


FIGURE 1. Representative call sequence portions of the species identified. Frequencies below 5 kHz and their upper harmonics derive from a cricket.

Appendix D

Existing Fauna Records for the Project area and Surrounds (Updated May 2013).

Appendix D – Existing Fauna Records for Twin Bonanza Project Area & Surrounds

Database searches: NT Atlas data (10 km radius of Wilsons Camp)

Status Key: LC – Least Concern; NT – Near Threatened; VU – Vulnerable; (Int) – Introduced.

Survey References: April 2012 (GHD 2012); Oct 2013 (EcOz 2013); May 2013 (this report)

Family	Scientific name	Common name	TPWC Status	Apr 2012	Oct 2012	May 2013	NT Atlas
REPTILES							
AGAMIDAE	<i>Ctenophorus isolepis</i>	Military Dragon	LC	X	X	X	
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon	LC		X	X	
	<i>Diporiphora winneckeii</i>	Cane grass Dragon	LC	X	X		
	<i>Pogona minor</i>	Dwarf Bearded Dragon	LC	X	X	X	
	<i>Tympanocryptis lineata</i>	Lined Earless Dragon	LC		X		
ELAPIDAE	<i>Pseudechis australis</i>	Mulga Snake	NT	X			
	<i>Suta punctata</i>	Little Spotted Snake	LC	X			
GEKKONIDAE	<i>Gehyra australis</i>	Northern Dtella	LC			X	
	<i>Gehyra variegata</i>	Tree Dtella	LC	X	X		
	<i>Lucasium stenodactylum</i>	Crowned Gecko	LC		X	X	
	<i>Nephurus laevisimus</i>	Smooth Knob-tailed Gecko	LC				X
	<i>Rhynchoedura ornata</i>	Beaked Gecko	LC	X	X	X	
	<i>Strophurus ciliaris</i>	Spiny-tailed Gecko	LC	X	X	X	
PYGOPODIDAE	<i>Delma borea</i>	Rusty-topped Delma	LC	X	X		
	<i>Delma butleri</i>	Unbanded Delma	LC		X		
	<i>Lialis burtonis</i>	Burton's Legless Lizard	LC				X
PYTHONIDAE	<i>Aspidites melanocephalus</i>	Black-headed Python	LC	X			X
SCINCIDAE	<i>Carlia triacantha</i>	Three-spined Rainbow Skink	LC	X	X		
	<i>Cryptoblepharus metallicus</i>	Metallic Snake-eyed Skink	(NL)	X			
	<i>Ctenotus helenae</i>	Helen's Ctenotus	LC	X	X	X	
	<i>Ctenotus pantherinus</i>	Leopard Ctenotus	LC	X	X	X	
	<i>Ctenotus piankai</i>	Pianka's Ctenotus	LC	X	X		
	<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus	LC	X		X	
	<i>Ctenotus tanamiensis</i>	Tanami Ctenotus	LC	X	X	X	
	<i>Eremiascincus fasciolatus</i>	Narrow-banded Sand-swimmer	LC			X	
	<i>Lerista bipes</i>	Two-toed Lerista	LC	X	X		X
	<i>Menetia greyii</i>	Grey's Menetia	LC	X	X	X	
VARANIDAE	<i>Varanus acanthurus</i>	Spiny-tailed Monitor	LC			X	
	<i>Varanus eremius</i>	Rusty Desert Monitor	LC	X	X		
	<i>Varanus gouldii</i>	Sand Goanna	LC			X	
REPTILES TOTAL	30 Species			20	19	15	4

Family	Scientific name	Common name	TPWC Status	Apr 2012	Oct 2012	May 2013	NT Atlas
BIRDS							
ACANTHIZIDAE	<i>Smicrornis brevirostris</i>	Wee bill	LC	X			
ACCIPITRIDAE	<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	LC	X			
	<i>Accipiter fasciatus</i>	Brown Goshawk	LC	X	X	X	
	<i>Aquila audax</i>	Wedge-tailed Eagle	LC			X	
	<i>Circus assimilis</i>	Spotted Harrier	LC	X	X	X	
	<i>Elanus axillaris</i>	Black-shouldered Kite	LC	X	X	X	
	<i>Haliastur indus</i>	Whistling Kite	LC			X	
	<i>Milvus migrans</i>	Black Kite	LC	X			
ANATIDAE	<i>Anas gracilis</i>	Grey Teal	LC		X		
ARTAMIDAE	<i>Artamus cinereus</i>	Black-faced Wood swallow	LC	X	X	X	
	<i>Artamus personatus</i>	Masked Wood swallow	LC	X	X		
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	LC	X		X	
CACATUIDAE	<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	LC			X	
CAMPEPHAGIDAE	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	LC	X			
	<i>Lalage sueurii</i>	White-winged Triller	LC	X			
COLUMBIDAE	<i>Geopelia cuneata</i>	Diamond Dove	LC	X		X	
	<i>Geopelia striata</i>	Peaceful Dove	LC		X		
	<i>Ocyphaps lophotes</i>	Crested Pigeon	LC	X		X	
CORVIDAE	<i>Corvus bennettii</i>	Little Crow	LC	X		X	
	<i>Corvus orru</i>	Torresiana Crow	LC		X	X	
CUCULIDAE	<i>Cacomantis pallidus</i>	Pallid Cuckoo	LC			X	
ESTRILDIDAE	<i>Emblema pictum</i>	Painted Finch	LC	X			
	<i>Taeniopygia guttata</i>	Zebra Finch	LC	X	X	X	
EUROSTOPDIDAE	<i>Eurostopodus argus</i>	Spotted Nightjar	LC	X	X	X	
FALCONIDAE	<i>Falco berigora</i>	Brown Falcon	LC	X	X	X	
	<i>Falco cenchroides</i>	Nankeen Kestrel	LC	X		X	
	<i>Falco longipennis</i>	Australian Hobby	LC	X			
	<i>Falco subniger</i>	Black Falcon	LC	X	X	X	
HALYCONIDAE	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher	LC	X		X	
MALURIDAE	<i>Amytornis striatus</i>	Striated Grass wren	NT	X			
	<i>Malurus lamberti</i>	Variegated Fairy-wren	LC	X	X	X	
	<i>Malurus leucopterus</i>	White-winged Fairy-wren	LC	X		X	
	<i>Stipiturus ruficeps</i>	Rufous-crowned Emu-wren	LC			X	
MEGALURIDAE	<i>Cincloramphus cruralis</i>	Brown Song lark	LC	X			
	<i>Cincloramphus mathewsi</i>	Rufous Song lark	LC	X			
	<i>Eremiornis carteri</i>	Spinifex bird	LC	X	X	X	
MELIPHAGIDAE	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	LC	X	X		
	<i>Epthianura tricolor</i>	Crimson Chat	LC	X		X	

Family	Scientific name	Common name	TPWC Status	Apr 2012	Oct 2012	May 2013	NT Atlas
	<i>Lichenostomus keartlandi</i>	Grey-headed Honeyeater	LC	X		X	
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	LC			X	
	<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater	LC		X		
	<i>Lichenostomus virescens</i>	Singing Honeyeater	LC	X	X	X	
	<i>Manorina flavigula</i>	Yellow-throated Miner	LC	X		X	
	<i>Melithreptus gularis</i>	Black-chinned Honeyeater	LC	X	X		
MOTACILLIDAE	<i>Anthus novaeseelandiae</i>	Australasian Pipit	LC			X	
NECTARINIIDAE	<i>Dicaeum hirundinaceum</i>	Mistletoe bird	LC	X			
OTIDIDAE	<i>Ardeotis australis</i>	Australian Bustard	NT	X	X	X	
PACHYCEPHALIDAE	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	LC	X		X	
	<i>Oreoica gutturalis</i>	Crested Bellbird	LC	X	X	X	
	<i>Pachycephala rufiventris</i>	Rufous Whistler	LC	X		X	
PARDALOTIDAE	<i>Pardalotus rubricatus</i>	Red-browed Pardalote	LC	X	X	X	
PODARGIDAE	<i>Podargus strigoides</i>	Tawny Frogmouth	LC	X	X	X	
PSITTACIDAE	<i>Barnardius zonarius</i>	Australian Ringneck	LC	X		X	
	<i>Melopsittacus undulatus</i>	Budgerigar	LC	X	X	X	
	<i>Nymphicus hollandicus</i>	Cockatiel	LC			X	
RHIPIDURIDAE	<i>Rhipidura leucophrys</i>	Willie Wagtail	LC	X	X	X	
STRIGIDAE	<i>Ninox novaeseelandiae</i>	Southern Boobook	LC		X	X	
TURNICIDAE	<i>Turnix velox</i>	Little Button-quail	LC	X	X	X	
BIRDS TOTAL	58 Species			45	20	31	0
MAMMALS							
CAMELIDAE	<i>Camelus dromedarius</i>	Camel	(Int)	X		X	
CANIDAE	<i>Canis lupus</i>	Dingo	LC	X	X	X	
DASYURIDAE	<i>Dasyercus blythi</i>	Brush-tailed Mulgara	VU	X	X	X	
	<i>Pseudantechinus macdonnellensis</i>	Fat-tailed False Antechinus	LC			X	
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	LC	X	X	X	
	<i>Sminthopsis youngsoni</i>	Lesser Hairy-footed Dunnart	LC	X	X	X	
EMBALLONURIDAE	<i>Saccolaimus flaviventris</i>	Yellow-bellied sheath-tailed Bat	LC			X	
FELIDAE	<i>Felis catus</i>	Feral Cat	(Int)	X		X	
MACROPODIDAE	<i>Macropus rufus</i>	Red Kangaroo	LC			X	
MOLOSSIDAE	<i>Chaerephon jobensis</i>	Northern Free tail Bat	LC	X			
	<i>Tadarida australis</i>	White-striped Free-tailed Bat	LC			X	
MURIDAE	<i>Mus musculus</i>	House Mouse	(Int)		X		
	<i>Notomys alexis</i>	Spinifex Hopping-mouse	LC	X	X	X	X

Family	Scientific name	Common name	TPWC Status	Apr 2012	Oct 2012	May 2013	NT Atlas
	<i>Pseudomys desertor</i>	Desert Mouse	LC	X			
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	LC	X	X	X	
	<i>Pseudomys johnsoni</i>	Central Pebble-mound Mouse	NT	X			
	<i>Pseudomys nanus</i>	Western Chestnut Mouse	NT	X	X	X	
THYLACOMIDAE	<i>Macrotis lagotis</i>	Bilby	VU	X	X	X	
VESPERTILIONIDAE	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	LC	X	X	X	
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	LC	X		X	
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	LC	X			
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat	LC	X		X	
	<i>Vespadelus baverstocki</i>	Inland Forest-bat	LC	X			
	<i>Vespadelus finlaysoni</i>	Inland Cave-bat	LC	X			
MAMMALS TOTAL	24 Species			19	10	17	1
TOTAL SPECIES	112 Species			84	49	63	5

Appendix E

Flora Survey Results May 2013

Appendix E – Flora species list and structural information for all survey sites, May 2013

Key: ■ = Upper Stratum; ■ = Mid Stratum; ■ = Ground Stratum

Numerical values denote percentage cover estimates

Individual plant number estimates are denoted with a = 1 to 5 plants; b = 6 to 50 plants; c = > 50 plants

Family	Botanical name	Site 1									Site 2								Check Sites						
		B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	1	1 A	2	3	4	5	6	7
AMARANTHACEAE	<i>Alternanthera angustifolia</i>													a											
	<i>Alternanthera nana</i>										a				a		a								
	<i>Ptilotus astrolasius</i>					a	a																		
	<i>Ptilotus calostachyus</i>								a	a															
	<i>Ptilotus fusiformis</i>								a																
APOCYNACEAE	<i>Carissa lanceolata</i>																	a							
	<i>Marsdenia australis</i>		a						a	a															
	<i>Rhyncharrhena linearis</i>					a																			
ASTERACEAE	<i>Pluchea tetranthera</i>								a	a		a											b		
BORAGINACEAE	<i>Ehretia saligna</i>	2																							
	<i>Halgania solanacea</i>		a		1	b	a		a																
	<i>Heliotropium skeleton</i>				a																				
	<i>Heliotropium tenuifolium</i>															a									
CAPPARACEAE	<i>Capparis umbonata</i>												a										a		
CELASTRACEAE	<i>Stackhousia clementii</i>																a								
CLEOMACEAE	<i>Cleome viscosa</i>					a								a											
CONVOLVULACEAE	<i>Evolvulus alsinoides</i>					a		a			b			a	a	a	a	9							
CUCURBITACEAE	<i>Cucumis maderaspatanus</i>								a			a					a								
CYPERACEAE	<i>Fimbristylis dichotoma</i>	a							a								2								
	<i>Fimbristylis littoralis</i>										b		b												

Family	Botanical name	Site 1								Site 2								Check Sites							
		B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	1	1 A	2	3	4	5	6	7
ELATINACEAE	<i>Bergia henshallii</i>																	a							
	<i>Bergia perennis</i> subsp. <i>perennis</i>														a										
EUPHORBIACEAE	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>		a																						
FABACEAE	<i>Acacia adoxa</i>			a	c		a			a													1	b	
	<i>Acacia adsurgens</i>		a						10												1				
	<i>Acacia ancistrocarpa</i>		a						3								a								
	<i>Acacia aneura</i>													70											
														10											
	<i>Acacia cuthbertsonii</i>	a																							
	<i>Acacia elachantha</i>										a	b	b			a	a	a			<1				
																						2			
	<i>Acacia hilliana</i>			a																					
	<i>Acacia lysiphloia</i>			b		a		a					15								5				5
	<i>Acacia sericophylla</i>	2	1										1	a	2					2	1	<1			
													4								2	2	2		
	<i>Acacia stipuligera</i>						a		a							a									
	<i>Acacia tenuissima</i>	a	2					a	a				a	a							3	c			
	<i>Indigofera georgei</i>																	1							
	<i>Leptosema anomalum</i>					a						a	a			b									
	<i>Mirbelia viminalis</i>				2	a	a																		
	<i>Senna artemisioides</i>				a																				
	<i>Senna artemisioides</i> subsp. <i>helmsii</i>																								
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	a				b		a									b								
<i>Senna artemisioides</i> subsp. <i>quadrifolia</i>																									
<i>Senna notabilis</i>				b	a		b	a	a	a	a					b									
<i>Senna oligoclada</i>																				a					

Family	Botanical name	Site 1									Site 2								Check Sites						
		B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	1	1 A	2	3	4	5	6	7
	<i>Tephrosia brachycarpa</i>														a										
	<i>Tephrosia leptoclada</i>			a																					
	<i>Zornia muelleriana</i>					a						b		a											
GOODENIACEAE	<i>Dampiera cinerea</i>				a																				
	<i>Goodenia armitiana</i>					a		a		a					a	a									
	<i>Goodenia azurea</i>				b																				
	<i>Scaevola parvifolia</i>					a																			
HALORAGACEAE	<i>Haloragis uncatipila</i>					b	a				b	a			b										
LAMIACEAE	<i>Clerodendrum floribundum</i>										a														
LAURACEAE	<i>Cassytha filiformis</i>								5						a										<1
MALVACEAE	<i>Abutilon leucopetalum</i>							a																	
	<i>Abutilon macrum</i>													a											
	<i>Corchorus sidoides</i>													b				a							
	<i>Corchorus sidoides subsp. vermicularis</i>					a		a	a																
	<i>Gossypium australe</i>	a	a					a							a	a		b							
	<i>Hibiscus leptocladus</i>				a		a			a					a		a								
	<i>Hibiscus sturtii</i>									a															
	<i>Sida A86753 Pindan</i>				a			a																	
	<i>Sida arenicola</i>				a	a			a								a								
	<i>Sida cardiophylla</i>																								
	<i>Sida fibulifera</i>							a																	
	<i>Sida filiformis</i>					a			a	a		a		5		a									
	<i>Sida laevis</i>				a																				
	<i>Sida macropoda</i>			a																					
<i>Sida sp.</i>				a				a																	




Family	Botanical name	Site 1									Site 2								Check Sites						
		B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	1	1 A	2	3	4	5	6	7
	<i>Triumfetta winneckeana</i>								a																
MENISPERMACEAE	<i>Tinospora smilacina</i>		a			a										a									
MYRTACEAE	<i>Corymbia aspera</i>						1 2											2							
	<i>Corymbia opaca</i>	2	8 a													1							<1		
	<i>Eucalyptus brevifolia</i>			2 5		a		2 1		6		2	6			2 4	1				<1 <2	<1 <1			
	<i>Eucalyptus gamophylla</i>									a		2					3								
	<i>Eucalyptus odontocarpa</i>																							1	
	<i>Eucalyptus victrix</i>	2 8										1				1		2	1						
POACEAE	<i>Aristida holathera</i>						b			b	b	3		1	a a		a						2		
	<i>Aristida latifolia</i>							a	b							b		a	<1						
	<i>Aristida pruinosa</i>										b														
	<i>Chrysopogon fallax</i>											3			a 3										
	<i>Cymbopogon obtectus</i>					a	a		5	a															
	<i>Digitaria brownii</i>							1																	
	<i>Enneapogon avenaceus</i>									a															
	<i>Eragrostis eriopoda</i>				a	a	15	b	a																
	<i>Eragrostis falcata</i>														2										
	<i>Eragrostis setifolia</i>										b	3	b				2	b						2	
	<i>Eriachne aristidea</i>															b									
	<i>Eriachne mucronata</i>										b														
	<i>Eulalia aurea</i>	a	a					b	b		a	20	b		3	a	a			3					
	<i>Paraneurachne muelleri</i>			a		b	b									b								b	
<i>Triodia basedowii</i>								5	12							8		10		8			15	10	





Family	Botanical name	Site 1								Site 2								Check Sites							
		B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	1	1A	2	3	4	5	6	7
	<i>Triodia bitextura</i>																						15		
	<i>Triodia pungens</i>	38	42	30				6	20		22	20	23	8	35		18	25	20	25		25			
	<i>Triodia schinzii</i>			5	22	1	10																		
	<i>Yakirra australiensis</i>							a																	
PROTEACEAE	<i>Grevillea wickhamii</i>			a		1	4		a	a					a		1						6	1	
	<i>Hakea lorea</i>				a	4						<1			2		a					a			<1
	<i>Hakea macrocarpa</i>	a		a	a		a																		
SANTALACEAE	<i>Santalum lanceolatum</i>											a													
SAPINDACEAE	<i>Dodonaea viscosa</i>		a						a																
SCROPHULARIACEAE	<i>Eremophila latrobei subsp. glabra</i>		a																						
	<i>Eremophila longifolia</i>													a	a		a								
SOLANACEAE	<i>Solanum diversiflorum</i>		a					a																	
	<i>Solanum quadriloculatum</i>		a					a						a			a								
	<i>Stylobasium spathulatum</i>							b																	
	Total number of species	11	17	10	17	25	15	21	27	16	19	18	8	15	22	15	19	8	9	10	3	3	6	4	3


Appendix F





Site Description Summaries May 2013




Appendix F – Site Description Summaries, Twin Bonanza Project, May 2013





Site – VS1B	Habitat and Vegetation						
	<p>Coordinates: 509150E 7765005N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Corymbia opaca</i> and <i>Eucalyptus victrix</i> open woodland with tall <i>Acacia sericophylla</i> and <i>Ehretia saligna</i> open shrubland over <i>Triodia pungens</i> open hummock grassland.</p> <p>Land Unit: Palaeochannel (Type II)</p> <p>Soil: Deep reddish sandy clay</p> <p>Rock: No surface or subsurface rocks present</p> <p>Weeds: Absent Fire Impact: Moderate Last Fire: 2009</p> <p>Hollows: Absent Termites: Small towers Flowers: Minimal</p> <table border="1"> <thead> <tr> <th>Upper stratum</th> <th>Mid stratum</th> <th>Lower stratum</th> </tr> </thead> <tbody> <tr> <td>5% cover, height 4-6m Richness = 2 species <i>Corymbia opaca</i> 2% <i>Eucalyptus victrix</i> 2%</td> <td>15% cover, height 1-4m Richness = 8 species <i>Eucalyptus victrix</i> 8% <i>Acacia sericophylla</i> 2% <i>Ehretia saligna</i> 2%</td> <td>40% cover, height <0.5m Richness = 11 species <i>Triodia pungens</i> 38% <i>Eulalia aurea</i> 1%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	5% cover, height 4-6m Richness = 2 species <i>Corymbia opaca</i> 2% <i>Eucalyptus victrix</i> 2%	15% cover, height 1-4m Richness = 8 species <i>Eucalyptus victrix</i> 8% <i>Acacia sericophylla</i> 2% <i>Ehretia saligna</i> 2%	40% cover, height <0.5m Richness = 11 species <i>Triodia pungens</i> 38% <i>Eulalia aurea</i> 1%
Upper stratum	Mid stratum	Lower stratum					
5% cover, height 4-6m Richness = 2 species <i>Corymbia opaca</i> 2% <i>Eucalyptus victrix</i> 2%	15% cover, height 1-4m Richness = 8 species <i>Eucalyptus victrix</i> 8% <i>Acacia sericophylla</i> 2% <i>Ehretia saligna</i> 2%	40% cover, height <0.5m Richness = 11 species <i>Triodia pungens</i> 38% <i>Eulalia aurea</i> 1%					
	<p>Coordinates: 508741E 7765202N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Corymbia opaca</i> open woodland with tall <i>Acacia tenuissima</i> and <i>A. sericophylla</i> open shrubland over <i>Triodia pungens</i> open hummock grassland.</p> <p>Land Unit: Loamy sand plain</p> <p>Soil: Deep reddish clay</p> <p>Rock: No surface or subsurface rocks present</p> <p>Weeds: Absent Fire Impact: Moderate Last Fire: 2009</p> <p>Hollows: Absent Termites: Small towers Flowers: Minimal</p> <table border="1"> <thead> <tr> <th>Upper stratum</th> <th>Mid stratum</th> <th>Lower stratum</th> </tr> </thead> <tbody> <tr> <td>8% cover, height 4-7m Richness = 1 species <i>Corymbia opaca</i> 8%</td> <td>6% cover, height 0.6-4m Richness = 10 species <i>Acacia tenuissima</i> 2% <i>Acacia sericophylla</i> 1%</td> <td>45% cover, height <0.6m Richness = 7 species <i>Triodia pungens</i> 42% <i>Eulalia aurea</i> 2%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	8% cover, height 4-7m Richness = 1 species <i>Corymbia opaca</i> 8%	6% cover, height 0.6-4m Richness = 10 species <i>Acacia tenuissima</i> 2% <i>Acacia sericophylla</i> 1%	45% cover, height <0.6m Richness = 7 species <i>Triodia pungens</i> 42% <i>Eulalia aurea</i> 2%
Upper stratum	Mid stratum	Lower stratum					
8% cover, height 4-7m Richness = 1 species <i>Corymbia opaca</i> 8%	6% cover, height 0.6-4m Richness = 10 species <i>Acacia tenuissima</i> 2% <i>Acacia sericophylla</i> 1%	45% cover, height <0.6m Richness = 7 species <i>Triodia pungens</i> 42% <i>Eulalia aurea</i> 2%					
	<p>Coordinates: 512298E 7765916N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Eucalyptus brevifolia</i> open woodland over <i>Triodia pungens</i> and <i>T. schinzii</i> open hummock grassland.</p> <p>Land Unit: Boundary of loamy sand plain to rocky rise (no outcropping)</p> <p>Soil: Deep reddish brown clayey sand</p> <p>Rock: Laterite rock present, only minor amounts.</p> <p>Weeds: Absent Fire Impact: Moderate Last Fire: 2009</p> <p>Hollows: Scattered Termites: Small towers Flowers: Minimal</p> <table border="1"> <thead> <tr> <th>Upper stratum</th> <th>Mid stratum</th> <th>Lower stratum</th> </tr> </thead> <tbody> <tr> <td>2% cover, height 4-5m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%</td> <td>6% cover, height 0.5-4m Richness = 4 species <i>Eucalyptus brevifolia</i> 5%</td> <td>35% cover, height <0.5m Richness = 6 species <i>Triodia pungens</i> 30% <i>Triodia schinzii</i> 5%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	2% cover, height 4-5m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%	6% cover, height 0.5-4m Richness = 4 species <i>Eucalyptus brevifolia</i> 5%	35% cover, height <0.5m Richness = 6 species <i>Triodia pungens</i> 30% <i>Triodia schinzii</i> 5%
Upper stratum	Mid stratum	Lower stratum					
2% cover, height 4-5m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%	6% cover, height 0.5-4m Richness = 4 species <i>Eucalyptus brevifolia</i> 5%	35% cover, height <0.5m Richness = 6 species <i>Triodia pungens</i> 30% <i>Triodia schinzii</i> 5%					
	<p>Coordinates: 517335E 7767920N (GDA94 Zone 52)</p> <p>Vegetation Description: <i>Triodia schinzii</i> open hummock grassland.</p> <p>Land Unit: Lateritic Sand Plain</p> <p>Soil: Deep reddish brown sandy clay</p> <p>Rock: Minor surface gravel</p> <p>Weeds: Absent Fire Impact: Very High Last Fire: 2009</p> <p>Hollows: Absent Termites: absent Flowers: absent</p> <table border="1"> <thead> <tr> <th>Upper stratum</th> <th>Mid stratum</th> <th>Lower stratum</th> </tr> </thead> <tbody> <tr> <td>0% cover, height 0m Richness = 0 species Absent</td> <td><1% cover, height 1-3m Richness = 1 species Absent</td> <td>25% cover, height <0.5m Richness = 17 species <i>Triodia schinzii</i> 22% <i>Mirbelia viminalis</i> 2%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	0% cover, height 0m Richness = 0 species Absent	<1% cover, height 1-3m Richness = 1 species Absent	25% cover, height <0.5m Richness = 17 species <i>Triodia schinzii</i> 22% <i>Mirbelia viminalis</i> 2%
Upper stratum	Mid stratum	Lower stratum					
0% cover, height 0m Richness = 0 species Absent	<1% cover, height 1-3m Richness = 1 species Absent	25% cover, height <0.5m Richness = 17 species <i>Triodia schinzii</i> 22% <i>Mirbelia viminalis</i> 2%					

Site – VS1F	Habitat and Vegetation		
	Coordinates: 516652E 7769171N (GDA94 Zone 52)		
	Vegetation Description: Low <i>Hakea lorea</i> isolated trees with mid high <i>Grevillea wickhamii</i> and <i>Eucalyptus brevifolia</i> isolated shrubs over <i>Triodia schinzii</i> sparse hummock grassland.		
Land Unit: Lateritic Sand Plain			
Soil: Deep reddish brown sandy clay			
Rock: Minor surface gravel			
Weeds: Absent	Fire Impact: High	Last Fire: 2011	
Hollows: Absent	Termites: isolated tower	Flowers: Absent	
Upper stratum 4% cover, height 5-6m Richness = 1 species <i>Hakea lorea</i> 4%	Mid stratum 2% cover, height 0.5-2m Richness = 2 species <i>Grevillea wickhamii</i> 1% <i>Eucalyptus brevifolia</i> 1%	Lower stratum 15% cover, height <0.5m Richness = 22 species <i>Triodia schinzii</i> 1%	
Site – VS1G	Habitat and Vegetation		
	Coordinates: 516704E 7770400N (GDA94 Zone 52)		
	Vegetation Description: Low <i>Corymbia aspera</i> isolated trees with tall <i>Grevillea wickhamii</i> open shrubland over <i>Eragrostis eriopoda</i> and <i>Triodia schinzii</i> open tussock/hummock grassland.		
Land Unit: Loamy Sand Plain			
Soil: Deep reddish brown sand			
Rock: Absent			
Weeds: Absent	Fire Impact: Very High	Last Fire: 2011	
Hollows: Absent	Termites: Absent	Flowers: Absent	
Upper stratum 1% cover, height 4-5m Richness = 1 species <i>Corymbia aspera</i> 1%	Mid stratum 8% cover, height 0.5-4m Richness = 2 species <i>Grevillea wickhamii</i> 4% <i>Corymbia aspera</i> 2%	Lower stratum 25% cover, height <0.5m Richness = 13 species <i>Eragrostis eriopoda</i> 15% <i>Triodia schinzii</i> 10% <i>Acacia stipuligera</i> 1%	
Site – VS1H	Habitat and Vegetation		
	Coordinates: 516081704E 7770141N (GDA94 Zone 52)		
	Vegetation Description: Low <i>Eucalyptus brevifolia</i> isolated trees over <i>Triodia pungens</i> sparse hummock grassland.		
Land Unit: Lateritic Sand Plain			
Soil: Deep reddish brown sand			
Rock: Minor surface gravel			
Weeds: Absent	Fire Impact: High	Last Fire: 2011	
Hollows: Absent	Termites: Small towers	Flowers: Absent	
Upper stratum 2% cover, height 4-5m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%	Mid stratum 1% cover, height 0.5-3m Richness = 1 species <i>Eucalyptus brevifolia</i> 1%	Lower stratum 10% cover, height <0.5m Richness = 20 species <i>Triodia pungens</i> 6% <i>Digitaria brownii</i> 1%	
Site – VS1I	Habitat and Vegetation		
	Coordinates: 510497E 7765256N (GDA94 Zone 52)		
	Vegetation Description: Low <i>Acacia adsurgens</i> and <i>A. ancistrocarpa</i> open woodland over <i>Triodia pungens</i> and <i>T. basedowii</i> open hummock grassland		
Land Unit: Loamy Sand Plain			
Soil: Deep reddish clayey sand			
Rock: Absent			
Weeds: Absent	Fire Impact: Low	Last Fire: 2009	
Hollows: Absent	Termites: Low mounds	Flowers: Acacia (minor)	
Upper stratum 0% cover, height 0m Richness = 0 species Absent	Mid stratum 18% cover, height 1-3m Richness = 6 species <i>Acacia adsurgens</i> 10% <i>A. ancistrocarpa</i> 3%	Lower stratum 30% cover, height <0.5m Richness = 21 species <i>Triodia pungens</i> 20% <i>Triodia basedowii</i> 10% <i>Cassytha filiformis</i> 5%	

Site – VS2A	Habitat and Vegetation																			
	Coordinates: 517218E 7772500N (GDA94 Zone 52)																			
	Vegetation Description: Low <i>Eucalyptus brevifolia</i> isolated trees over low <i>Triodia basedowii</i> sparse hummock grassland.																			
	Land Unit: Lateritic Sand Plain																			
Soil: Shallow reddish gravelly sand																				
Rock: Minor surface gravel																				
Weeds: Absent																				
Hollows: Absent																				
Fire Impact: Moderate																				
Termites: small, sparse																				
Last Fire: 2011																				
Flowers: Absent																				
<table border="0" style="width:100%"> <tr> <td style="text-align:center">Upper stratum</td> <td style="text-align:center">Mid stratum</td> <td style="text-align:center">Lower stratum</td> </tr> <tr> <td>0% cover, height 0m</td> <td>6% cover, height 0.5-4m</td> <td>15% cover, height <0.5m</td> </tr> <tr> <td>Richness = 0 species</td> <td>Richness = 1 species</td> <td>Richness = 15 species</td> </tr> <tr> <td>Absent</td> <td><i>Eucalyptus brevifolia</i> 6%</td> <td><i>Triodia basedowii</i> 12%</td> </tr> </table>			Upper stratum	Mid stratum	Lower stratum	0% cover, height 0m	6% cover, height 0.5-4m	15% cover, height <0.5m	Richness = 0 species	Richness = 1 species	Richness = 15 species	Absent	<i>Eucalyptus brevifolia</i> 6%	<i>Triodia basedowii</i> 12%						
Upper stratum	Mid stratum	Lower stratum																		
0% cover, height 0m	6% cover, height 0.5-4m	15% cover, height <0.5m																		
Richness = 0 species	Richness = 1 species	Richness = 15 species																		
Absent	<i>Eucalyptus brevifolia</i> 6%	<i>Triodia basedowii</i> 12%																		
Site – VS2B	Habitat and Vegetation																			
	Coordinates: 515133E 7773226N (GDA94 Zone 52)																			
	Vegetation Description: Low <i>Acacia sericophylla</i> isolated trees with tall <i>A. sericophylla</i> and <i>Eucalyptus victrix</i> open shrubland over <i>Triodia pungens</i> open hummock grassland																			
	Land Unit: Palaeochannel (Type 2)																			
Soil: Reddish clayey sand																				
Rock: Absent																				
Weeds: Absent																				
Hollows: Scattered																				
Fire Impact: High																				
Termites: Common																				
Last Fire: 2011																				
Flowers: Absent																				
<table border="0" style="width:100%"> <tr> <td style="text-align:center">Upper stratum</td> <td style="text-align:center">Mid stratum</td> <td style="text-align:center">Lower stratum</td> </tr> <tr> <td>1% cover, height 4-5m</td> <td>6% cover, height 0.5-3m</td> <td>30% cover, height <0.5m</td> </tr> <tr> <td>Richness = 1 species</td> <td>Richness = 3 species</td> <td>Richness = 15 species</td> </tr> <tr> <td><i>Acacia sericophylla</i> 1%</td> <td><i>Acacia sericophylla</i> 4%</td> <td><i>Triodia pungens</i> 22%</td> </tr> <tr> <td></td> <td><i>Eucalyptus victrix</i> 1%</td> <td><i>Chrysopogon fallax</i> 3%</td> </tr> <tr> <td></td> <td></td> <td><i>Eragrostis setifolia</i> 3%</td> </tr> </table>			Upper stratum	Mid stratum	Lower stratum	1% cover, height 4-5m	6% cover, height 0.5-3m	30% cover, height <0.5m	Richness = 1 species	Richness = 3 species	Richness = 15 species	<i>Acacia sericophylla</i> 1%	<i>Acacia sericophylla</i> 4%	<i>Triodia pungens</i> 22%		<i>Eucalyptus victrix</i> 1%	<i>Chrysopogon fallax</i> 3%			<i>Eragrostis setifolia</i> 3%
Upper stratum	Mid stratum	Lower stratum																		
1% cover, height 4-5m	6% cover, height 0.5-3m	30% cover, height <0.5m																		
Richness = 1 species	Richness = 3 species	Richness = 15 species																		
<i>Acacia sericophylla</i> 1%	<i>Acacia sericophylla</i> 4%	<i>Triodia pungens</i> 22%																		
	<i>Eucalyptus victrix</i> 1%	<i>Chrysopogon fallax</i> 3%																		
		<i>Eragrostis setifolia</i> 3%																		
Site – VS2C	Habitat and Vegetation																			
	Coordinates: 514135E 7773199N (GDA94 Zone 52)																			
	Vegetation Description: Low <i>Hakea lorea</i> isolated trees with low <i>Acacia lysiphloia</i> , <i>Eucalyptus brevifolia</i> and <i>E. gamophylla</i> open woodland over <i>Eulalia aurea</i> open tussock grassland and <i>Triodia pungens</i> hummock grassland																			
	Land Unit: Loamy Sand Plain																			
Soil: Deep Reddish clayey sand																				
Rock: Absent																				
Weeds: Absent																				
Hollows: Absent																				
Fire Impact: Moderate																				
Termites: Common																				
Last Fire: 2011																				
Flowers: <i>Acacia</i> (minor)																				
<table border="0" style="width:100%"> <tr> <td style="text-align:center">Upper stratum</td> <td style="text-align:center">Mid stratum</td> <td style="text-align:center">Lower stratum</td> </tr> <tr> <td><1% cover, height 3-5m</td> <td>18% cover, height 1-3m</td> <td>50% cover, height <0.6m</td> </tr> <tr> <td>Richness = 1 species</td> <td>Richness = 10 species</td> <td>Richness = 8 species</td> </tr> <tr> <td><i>Hakea lorea</i> <1%</td> <td><i>Acacia lysiphloia</i> 15%</td> <td><i>Eulalia aurea</i> 20%</td> </tr> <tr> <td></td> <td><i>Eucalyptus brevifolia</i> 2%</td> <td><i>Triodia pungens</i> 20%</td> </tr> <tr> <td></td> <td><i>Eucalyptus gamophylla</i> 2%</td> <td><i>Aristida holathera</i> 3%</td> </tr> </table>			Upper stratum	Mid stratum	Lower stratum	<1% cover, height 3-5m	18% cover, height 1-3m	50% cover, height <0.6m	Richness = 1 species	Richness = 10 species	Richness = 8 species	<i>Hakea lorea</i> <1%	<i>Acacia lysiphloia</i> 15%	<i>Eulalia aurea</i> 20%		<i>Eucalyptus brevifolia</i> 2%	<i>Triodia pungens</i> 20%		<i>Eucalyptus gamophylla</i> 2%	<i>Aristida holathera</i> 3%
Upper stratum	Mid stratum	Lower stratum																		
<1% cover, height 3-5m	18% cover, height 1-3m	50% cover, height <0.6m																		
Richness = 1 species	Richness = 10 species	Richness = 8 species																		
<i>Hakea lorea</i> <1%	<i>Acacia lysiphloia</i> 15%	<i>Eulalia aurea</i> 20%																		
	<i>Eucalyptus brevifolia</i> 2%	<i>Triodia pungens</i> 20%																		
	<i>Eucalyptus gamophylla</i> 2%	<i>Aristida holathera</i> 3%																		
Site – VS2D	Habitat and Vegetation																			
	Coordinates: 516862E 7775095N (GDA94 Zone 52)																			
	Vegetation Description: Low <i>Eucalyptus brevifolia</i> open woodland over low <i>Triodia pungens</i> open hummock grassland.																			
	Land Unit: Palaeochannel (Type 2)																			
Soil: Deep reddish clayey sand																				
Rock: Absent																				
Weeds: Absent																				
Hollows: Absent																				
Fire Impact: Low																				
Termites: Small towers																				
Last Fire: 2011																				
Flowers: Absent																				
<table border="0" style="width:100%"> <tr> <td style="text-align:center">Upper stratum</td> <td style="text-align:center">Mid stratum</td> <td style="text-align:center">Lower stratum</td> </tr> <tr> <td>6% cover, height 5-7m</td> <td>2% cover, height 0.5-4m</td> <td>25% cover, height <0.5m</td> </tr> <tr> <td>Richness = 1 species</td> <td>Richness = 2 species</td> <td>Richness = 5 species</td> </tr> <tr> <td><i>Eucalyptus brevifolia</i> 6%</td> <td><i>Acacia sericophylla</i> 2%</td> <td><i>Triodia pungens</i> 23%</td> </tr> </table>			Upper stratum	Mid stratum	Lower stratum	6% cover, height 5-7m	2% cover, height 0.5-4m	25% cover, height <0.5m	Richness = 1 species	Richness = 2 species	Richness = 5 species	<i>Eucalyptus brevifolia</i> 6%	<i>Acacia sericophylla</i> 2%	<i>Triodia pungens</i> 23%						
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Site – VS2E	Habitat and Vegetation											
	<p>Coordinates: 518920E 7776797N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Acacia aneura</i> open forest over <i>Triodia pungens</i> sparse hummock grassland.</p> <p>Land Unit: Palaeochannel</p> <p>Soil: Deep reddish clayey sand</p> <p>Rock: Absent</p> <table border="0"> <tr> <td>Weeds: Absent</td> <td>Fire Impact: High</td> <td>Last Fire: Insert</td> </tr> <tr> <td>Hollows: Absent</td> <td>Termites: Small Tower</td> <td>Flowers: Absent</td> </tr> </table> <table border="0"> <tr> <td>Upper stratum 70% cover, height 4-7m Richness = 1 species <i>Acacia aneura</i> 70%</td> <td>Mid stratum 10% cover, height 1-4m Richness = 7 species <i>Acacia aneura</i> 10%</td> <td>Lower stratum 20% cover, height <0.5m Richness = 7 species <i>Triodia pungens</i> 8% <i>Sida filiformis</i> 5% <i>Chrysopogon fallax</i> 3% <i>Eragrostis falcata</i> 2% <i>Aristida holathera</i> 1%</td> </tr> </table>			Weeds: Absent	Fire Impact: High	Last Fire: Insert	Hollows: Absent	Termites: Small Tower	Flowers: Absent	Upper stratum 70% cover, height 4-7m Richness = 1 species <i>Acacia aneura</i> 70%	Mid stratum 10% cover, height 1-4m Richness = 7 species <i>Acacia aneura</i> 10%	Lower stratum 20% cover, height <0.5m Richness = 7 species <i>Triodia pungens</i> 8% <i>Sida filiformis</i> 5% <i>Chrysopogon fallax</i> 3% <i>Eragrostis falcata</i> 2% <i>Aristida holathera</i> 1%
Weeds: Absent	Fire Impact: High	Last Fire: Insert										
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	<p>Coordinates: 514258E 777531N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Eucalyptus victrix</i> and <i>H. lorea</i> isolated trees over <i>Triodia pungens</i> open tussock grassland.</p> <p>Land Unit: Palaeochannel</p> <p>Soil: Deep reddish clayey sand</p> <p>Rock: Absent</p> <table border="0"> <tr> <td>Weeds: Absent</td> <td>Fire Impact: Mod-high</td> <td>Last Fire: 2011</td> </tr> <tr> <td>Hollows: Absent</td> <td>Termites: Small Tower</td> <td>Flowers: Scattered</td> </tr> </table> <table border="0"> <tr> <td>Upper stratum 2% cover, height 6-7m Richness = 1 species <i>Hakea lorea</i> 2%</td> <td>Mid stratum 10% cover, height 1-3m Richness = 6 species <i>Eucalyptus victrix</i> 1% <i>Hakea lorea</i> 1%</td> <td>Lower stratum 40% cover, height <0.5m Richness = 17 species <i>Triodia pungens</i> 35% <i>Fimbristylis dichotoma</i> 2%</td> </tr> </table>			Weeds: Absent	Fire Impact: Mod-high	Last Fire: 2011	Hollows: Absent	Termites: Small Tower	Flowers: Scattered	Upper stratum 2% cover, height 6-7m Richness = 1 species <i>Hakea lorea</i> 2%	Mid stratum 10% cover, height 1-3m Richness = 6 species <i>Eucalyptus victrix</i> 1% <i>Hakea lorea</i> 1%	Lower stratum 40% cover, height <0.5m Richness = 17 species <i>Triodia pungens</i> 35% <i>Fimbristylis dichotoma</i> 2%
Weeds: Absent	Fire Impact: Mod-high	Last Fire: 2011										
Hollows: Absent	Termites: Small Tower	Flowers: Scattered										
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	<p>Coordinates: 512399E 777741N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Eucalyptus brevifolia</i> isolated trees over <i>Triodia basedowii</i> sparse hummock grassland.</p> <p>Land Unit: Rocky Outcropping</p> <p>Soil: Shallow reddish sandy gravel</p> <p>Rock: Rocky Rise</p> <table border="0"> <tr> <td>Weeds: Absent</td> <td>Fire Impact: Mod-high</td> <td>Last Fire: 2011</td> </tr> <tr> <td>Hollows: Absent</td> <td>Termite: Small Dome, Rare</td> <td>Flowers: Absent</td> </tr> </table> <table border="0"> <tr> <td>Upper stratum 2% cover, height 5-6m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%</td> <td>Mid stratum 4% cover, height 0.5-4m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%</td> <td>Lower stratum 10% cover, height <0.5m Richness = 14 species <i>Triodia basedowii</i> 8% <i>Eragrostis setifolia</i> 2%</td> </tr> </table>			Weeds: Absent	Fire Impact: Mod-high	Last Fire: 2011	Hollows: Absent	Termite: Small Dome, Rare	Flowers: Absent	Upper stratum 2% cover, height 5-6m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%	Mid stratum 4% cover, height 0.5-4m Richness = 1 species <i>Eucalyptus brevifolia</i> 2%	Lower stratum 10% cover, height <0.5m Richness = 14 species <i>Triodia basedowii</i> 8% <i>Eragrostis setifolia</i> 2%
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	<p>Coordinates: 515982E 7773201N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Corymbia opaca</i> isolated trees with low <i>Eucalyptus gamophylla</i> and <i>E. brevifolia</i> sparse woodland over <i>Triodia pungens</i> sparse hummock grassland.</p> <p>Land Unit: Palaeochannel (Type 2)</p> <p>Soil: Deep reddish brown sandy clay</p> <p>Rock: Absent</p> <table border="0"> <tr> <td>Weeds: Absent</td> <td>Fire Impact: Moderate</td> <td>Last Fire: 2011</td> </tr> <tr> <td>Hollows: Scattered</td> <td>Termites: Common Tower</td> <td>Flowers: Absent</td> </tr> </table> <table border="0"> <tr> <td>Upper stratum 1% cover, height 3-5m Richness = 1 species <i>Corymbia opaca</i> 1%</td> <td>Mid stratum 6% cover, height 0.5-3m Richness = 10 species <i>Eucalyptus gamophylla</i> 3% <i>Eucalyptus brevifolia</i> 1% <i>Grevillea wickhamii</i> 1%</td> <td>Lower stratum 20% cover, height <0.5m Richness = 9 species <i>Triodia pungens</i> 18% <i>Indigofera georgei</i> 1%</td> </tr> </table>			Weeds: Absent	Fire Impact: Moderate	Last Fire: 2011	Hollows: Scattered	Termites: Common Tower	Flowers: Absent	Upper stratum 1% cover, height 3-5m Richness = 1 species <i>Corymbia opaca</i> 1%	Mid stratum 6% cover, height 0.5-3m Richness = 10 species <i>Eucalyptus gamophylla</i> 3% <i>Eucalyptus brevifolia</i> 1% <i>Grevillea wickhamii</i> 1%	Lower stratum 20% cover, height <0.5m Richness = 9 species <i>Triodia pungens</i> 18% <i>Indigofera georgei</i> 1%
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Site – CS1	Habitat and Vegetation						
	<p>Coordinates: 509148E 7764902N (GDA94 Zone 52)</p> <p>Vegetation Description: Low isolated <i>Corymbia aspera</i> trees with low <i>Eucalyptus victrix</i> and <i>Acacia sericophylla</i> open woodland over <i>Triodia pungens</i> open hummock grassland.</p> <p>Land Unit: Palaeochannel (Type 2)</p> <p>Soil: Reddish brown sandy clay</p> <p>Rock: Absent</p> <p>Weeds: Absent Fire Impact: Moderate Last Fire: 2012</p> <p>Hollows: Absent Termites: Common Tower Flowers: Absent</p> <table border="0"> <tr> <td>Upper stratum</td> <td>Mid stratum</td> <td>Lower stratum</td> </tr> <tr> <td>2% cover, height 4-5m Richness = 1 species <i>Corymbia aspera</i> 2%</td> <td>5% cover, height 0.4-4m Richness = 3 species <i>Eucalyptus victrix</i> 2% <i>Acacia sericophylla</i> 2%</td> <td>25% cover, height <0.4m Richness = 4 species <i>Triodia pungens</i> 25%</td> </tr> </table>	Upper stratum	Mid stratum	Lower stratum	2% cover, height 4-5m Richness = 1 species <i>Corymbia aspera</i> 2%	5% cover, height 0.4-4m Richness = 3 species <i>Eucalyptus victrix</i> 2% <i>Acacia sericophylla</i> 2%	25% cover, height <0.4m Richness = 4 species <i>Triodia pungens</i> 25%
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	<p>Coordinates: 510168E 7765174N (GDA94 Zone 52)</p> <p>Vegetation Description: Low isolated <i>Eucalyptus victrix</i> and <i>Acacia sericophylla</i> trees with mid high <i>A. tenuissima</i> shrubland over <i>Triodia pungens</i> and <i>T. basedowii</i> open hummock grassland.</p> <p>Land Unit: Loamy Sand Plain</p> <p>Soil: Brownish Red clayey sand</p> <p>Rock: Absent</p> <p>Weeds: Absent Fire Impact: Moderate Last Fire: 2009</p> <p>Hollows: Absent Termites: Small Tower Flowers: Scattered</p> <table border="0"> <tr> <td>Upper stratum</td> <td>Mid stratum</td> <td>Lower stratum</td> </tr> <tr> <td>2% cover, height 4-5m Richness = 2 species <i>Eucalyptus victrix</i> 1% <i>Acacia sericophylla</i> 1%</td> <td>10% cover, height 1-4m Richness = 5 species <i>Acacia tenuissima</i> 3% <i>Acacia sericophylla</i> 2% <i>Acacia adsurgens</i> 1%</td> <td>30% cover, height <0.5m Richness = 3 species <i>Triodia pungens</i> 20% <i>Triodia basedowii</i> 10%</td> </tr> </table>	Upper stratum	Mid stratum	Lower stratum	2% cover, height 4-5m Richness = 2 species <i>Eucalyptus victrix</i> 1% <i>Acacia sericophylla</i> 1%	10% cover, height 1-4m Richness = 5 species <i>Acacia tenuissima</i> 3% <i>Acacia sericophylla</i> 2% <i>Acacia adsurgens</i> 1%	30% cover, height <0.5m Richness = 3 species <i>Triodia pungens</i> 20% <i>Triodia basedowii</i> 10%
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	<p>Coordinates: 522247E 7797091N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Acacia sericophylla</i> isolated trees over <i>Triodia pungens</i> open hummock grassland.</p> <p>Land Unit: Loamy Sand Plain</p> <p>Soil: Reddish brown clayey sand</p> <p>Rock: Absent</p> <p>Weeds: Absent Fire Impact: Moderate Last Fire: 2005</p> <p>Hollows: Absent Termites: 1m Towers Flowers: Absent</p> <table border="0"> <tr> <td>Upper stratum</td> <td>Mid stratum</td> <td>Lower stratum</td> </tr> <tr> <td>1% cover, height 5-7m Richness = 2 species Absent</td> <td>5% cover, height 0.5-4m Richness = 5 species <i>Acacia sericophylla</i> 2%</td> <td>30% cover, height <0.5 Richness = 5 species <i>Triodia pungens</i> 25% <i>Eulalia aurea</i> 3%</td> </tr> </table>	Upper stratum	Mid stratum	Lower stratum	1% cover, height 5-7m Richness = 2 species Absent	5% cover, height 0.5-4m Richness = 5 species <i>Acacia sericophylla</i> 2%	30% cover, height <0.5 Richness = 5 species <i>Triodia pungens</i> 25% <i>Eulalia aurea</i> 3%
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	<p>Coordinates: 520073E 7793103N (GDA94 Zone 52)</p> <p>Vegetation Description: Low <i>Eucalyptus brevifolia</i> isolated trees with low <i>Acacia hilliana</i> isolated shrubs over <i>Triodia basedowii</i> sparse hummock grassland.</p> <p>Land Unit: Rocky rise</p> <p>Soil: Reddish brown rocky gravel</p> <p>Rock: surface is covered in gravel (laterite and quartz pebbles)</p> <p>Weeds: Absent Fire Impact: Low Last Fire: 2011</p> <p>Hollows: Absent Termites: Absent Flowers: Absent</p> <table border="0"> <tr> <td>Upper stratum</td> <td>Mid stratum</td> <td>Lower stratum</td> </tr> <tr> <td><1% cover, height 3-4m Richness = 1 species <i>Eucalyptus brevifolia</i> <1%</td> <td><1% cover, height 1-3m Richness = 1 species Absent</td> <td>10% cover, height <0.5m Richness = 2 species <i>Triodia basedowii</i> 8% <i>Acacia hilliana</i> 2%</td> </tr> </table>	Upper stratum	Mid stratum	Lower stratum	<1% cover, height 3-4m Richness = 1 species <i>Eucalyptus brevifolia</i> <1%	<1% cover, height 1-3m Richness = 1 species Absent	10% cover, height <0.5m Richness = 2 species <i>Triodia basedowii</i> 8% <i>Acacia hilliana</i> 2%
Upper stratum	Mid stratum	Lower stratum					
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Site – CS4	Habitat and Vegetation					
	Coordinates: 518161E, 7789769N (GDA94 Zone 52)					
	Vegetation Description: <i>Corymbia opaca</i> isolated trees over <i>Triodia pungens</i> sparse hummock grassland.					
	Land Unit: Palaeochannel (Type 2) Soil: Red clayey sand Rock: Absent Weeds: Absent Fire Impact: Moderate Last Fire: 2011 Hollows: Absent Termites: Small Tower Flowers: Absent					
<table border="0"> <thead> <tr> <th data-bbox="624 510 938 539">Upper stratum</th> <th data-bbox="938 510 1193 539">Mid stratum</th> <th data-bbox="1193 510 1481 539">Lower stratum</th> </tr> </thead> <tbody> <tr> <td data-bbox="624 539 938 622"><1% cover, height 5-7m Richness = 1 species <i>Corymbia opaca</i> <1%</td> <td data-bbox="938 539 1193 622"><1% cover, height 1-4m Richness = 1 species Absent</td> <td data-bbox="1193 539 1481 622">7% cover, height <0.5m Richness = 1 species <i>Triodia pungens</i> 7%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	<1% cover, height 5-7m Richness = 1 species <i>Corymbia opaca</i> <1%	<1% cover, height 1-4m Richness = 1 species Absent	7% cover, height <0.5m Richness = 1 species <i>Triodia pungens</i> 7%
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	Coordinates: 516140E, 7772260N (GDA94 Zone 52)					
	Vegetation Description: Mid high <i>Grevillea wickhamii</i> shrubland over low <i>Triodia bitextura</i> sparse hummock grassland.					
	Land Unit: Loamy Sand Plain Soil: Red gravely sand Rock: Absent Weeds: Absent Fire Impact: Moderate Last Fire: 2011 Hollows: Absent Termites: Odd towers Flowers: Scattered					
<table border="0"> <thead> <tr> <th data-bbox="624 925 938 954">Upper stratum</th> <th data-bbox="938 925 1193 954">Mid stratum</th> <th data-bbox="1193 925 1481 954">Lower stratum</th> </tr> </thead> <tbody> <tr> <td data-bbox="624 954 938 1037">0% cover, height 0m Richness = 0 species Absent</td> <td data-bbox="938 954 1193 1037">6% cover, height 0.5-2m Richness = 1 species <i>Grevillea wickhamii</i> 6%</td> <td data-bbox="1193 954 1481 1037">20% cover, height <0.5m Richness = 5 species <i>Triodia bitextura</i> 15% <i>Aristida holathera</i> 2% <i>Eragrostis setifolia</i> 2% <i>Acacia adoxa</i> 1%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	0% cover, height 0m Richness = 0 species Absent	6% cover, height 0.5-2m Richness = 1 species <i>Grevillea wickhamii</i> 6%	20% cover, height <0.5m Richness = 5 species <i>Triodia bitextura</i> 15% <i>Aristida holathera</i> 2% <i>Eragrostis setifolia</i> 2% <i>Acacia adoxa</i> 1%
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	Coordinates: 512529E 7777632N (GDA94 Zone 52)					
	Vegetation Description: <i>Triodia basedowii</i> sparse hummock grassland.					
	Land Unit: Rock Rise Soil: Red gravely sand Rock: high cover of gravel & pebbles, no outcropping, laterite dominant, some quartz. Weeds: Absent Fire Impact: Moderate Last Fire: 2011 Hollows: Absent Termites: rare towers Flowers: Absent					
<table border="0"> <thead> <tr> <th data-bbox="624 1451 938 1480">Upper stratum</th> <th data-bbox="938 1451 1193 1480">Mid stratum</th> <th data-bbox="1193 1451 1481 1480">Lower stratum</th> </tr> </thead> <tbody> <tr> <td data-bbox="624 1480 938 1563">0% cover, height 0m Richness = 0 species</td> <td data-bbox="938 1480 1193 1563">2% cover, height 0.6-2m Richness = 2 species <i>Eucalyptus odontocarpa</i> 1% <i>Grevillea wickhamii</i> 1%</td> <td data-bbox="1193 1480 1481 1563">15% cover, height <0.6m Richness = 2 species <i>Triodia basedowii</i> 15%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	0% cover, height 0m Richness = 0 species	2% cover, height 0.6-2m Richness = 2 species <i>Eucalyptus odontocarpa</i> 1% <i>Grevillea wickhamii</i> 1%	15% cover, height <0.6m Richness = 2 species <i>Triodia basedowii</i> 15%
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	Coordinates: 517672E 7785585N (GDA94 Zone 52)					
	Vegetation Description: Low <i>Hakea lorea</i> trees with mid high <i>Acacia lysiphloia</i> shrubland over <i>T. basedowii</i> open hummock grassland.					
	Land Unit: Rocky rise Soil: Reddish brown rocky gravel Rock: high cover of gravel & pebbles, no outcropping, laterite and quartz. Weeds: Absent Fire Impact: Moderatet Last Fire: 2011 Hollows: Absent Termites: Absent Flowers: Scattered					
<table border="0"> <thead> <tr> <th data-bbox="624 1888 938 1917">Upper stratum</th> <th data-bbox="938 1888 1193 1917">Mid stratum</th> <th data-bbox="1193 1888 1481 1917">Lower stratum</th> </tr> </thead> <tbody> <tr> <td data-bbox="624 1917 938 2000"><1% cover, height 4m Richness = 1 species <i>Hakea lorea</i> <1%</td> <td data-bbox="938 1917 1193 2000">5% cover, height 0.5-3m Richness = 1 species <i>Acacia lysiphloia</i> 5%</td> <td data-bbox="1193 1917 1481 2000">10% cover, height <0.5m Richness = 1 species <i>Triodia basedowii</i> 8%</td> </tr> </tbody> </table>	Upper stratum	Mid stratum	Lower stratum	<1% cover, height 4m Richness = 1 species <i>Hakea lorea</i> <1%	5% cover, height 0.5-3m Richness = 1 species <i>Acacia lysiphloia</i> 5%	10% cover, height <0.5m Richness = 1 species <i>Triodia basedowii</i> 8%
Upper stratum	Mid stratum	Lower stratum				
<1% cover, height 4m Richness = 1 species <i>Hakea lorea</i> <1%	5% cover, height 0.5-3m Richness = 1 species <i>Acacia lysiphloia</i> 5%	10% cover, height <0.5m Richness = 1 species <i>Triodia basedowii</i> 8%				

Appendix G

Existing Flora Records for the Project area and Surrounds (Updated May 2013).

Appendix G – Existing Flora Records for Twin Bonanza Project Area & Surrounds

Surveys and Data: GHD 2012; this survey (EcOz 2013); NT Atlas data (10 km radius of Wilsons Camp).

Status Key (TPWC Act): LC – Least Concern; NE – Not Evaluated; NT – Near Threatened; DD – Data Deficient.

Status Key (Weed Management Act): N – Naturalised (i.e. Environmental Weed)

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
AIZOACEAE	<i>Trianthema pilosa</i>	LC			X
	<i>Trianthema triquetra</i>	LC			X
AMARANTHACEAE	<i>Achyranthes aspera</i>	LC			X
	<i>Alternanthera angustifolia</i>	NE		X	
	<i>Alternanthera nana</i>	LC	X	X	X
	<i>Gomphrena lanata</i>	LC			X
	<i>Maireana georgei</i>	LC			X
	<i>Maireana villosa</i>	LC			X
	<i>Ptilotus exaltatus</i> var. <i>exaltatus</i>	LC	X		
	<i>Ptilotus gaudichaudii</i>	-	X		
	<i>Ptilotus astrolasius</i>	LC	X	X	X
	<i>Ptilotus calostachyus</i>	LC	X	X	X
	<i>Ptilotus clementii</i>	LC			X
	<i>Ptilotus decipiens</i>	LC			X
	<i>Ptilotus fusiformis</i>	LC			X
	<i>Ptilotus helipteroides</i>	LC			X
	<i>Ptilotus macrocephalus</i>	LC			X
	<i>Ptilotus nobilis</i>	LC			X
	<i>Ptilotus obovatus</i>	LC			X
	<i>Ptilotus polystachyus</i>	LC			X
	<i>Rhagodia eremaea</i>	LC			X
	<i>Sclerolaena cornishiana</i>	LC			X
	<i>Sclerolaena crenata</i>	LC	X		
	<i>Sclerolaena cuneata</i>	LC			X
	<i>Sclerolaena eriacantha</i>	LC	X		X
	<i>Sclerolaena glabra</i>	LC			X
<i>Sclerolaena muelleri</i>	LC	X			
<i>Tecticornia verrucosa</i>	LC			X	
APOCYNACEAE	<i>Carissa lanceolata</i>	LC	X	X	X
	<i>Cynanchum floribundum</i>	LC			X
	<i>Cynanchum puberulum</i>	LC			X
	<i>Marsdenia</i> sp.? <i>viridiflora</i> (infertile)	LC	X		
ARALIACEAE	<i>Trachymene glaucifolia</i>	LC			X
	<i>Trachymene inflata</i>	NT			X
	<i>Trachymene villosa</i>	DD			X
ASCLEPIADACEAE	<i>Marsdenia australis</i>	LC	X	X	
	<i>Rhyncharhena linearis</i>	LC	X	X	
ASTERACEAE	<i>Pluchea ferdinandi-muelleri</i>	LC	X		

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
	<i>Pluchea tetranthera</i>	LC	X	X	
	<i>Pterocaulon serrulatum</i>	LC			X
	<i>Pterocaulon serrulatum</i> var. <i>serrulatum</i>	LC	X		
	<i>Pterocaulon sphaeranthoides</i>	DD			X
	<i>Rhodanthe floribunda</i>	LC			X
	<i>Rutidosis helichrysoides</i>	LC			X
	<i>Streptoglossa bubakii</i>	LC			X
	<i>Vittadinia virgata</i>	LC	X		
BORAGINACEAE	<i>Ehretia saligna</i>	NE		X	
	<i>Halgania solanacea</i>	LC		X	X
	<i>Halgania solanacea</i> var. <i>Rabbit Flat</i>	LC	X		
	<i>Heliotropium diversifolium</i>	LC			X
	<i>Heliotropium glabellum</i>	LC			X
	<i>Heliotropium haesum</i>	LC			X
	<i>Heliotropium ovalifolium</i>	LC			X
	<i>Heliotropium pachyphyllum</i>	LC	X		X
	<i>Heliotropium parviantrum</i>	DD	X		
	<i>Heliotropium sphaericum</i>	DD			X
	<i>Heliotropium tanythrix</i>	LC	X		X
	<i>Heliotropium tenuifolium</i>	LC			X
<i>Trichodesma zeylanicum</i>	LC			X	
BRASSICACEAE	<i>Stenopetalum nutans</i>	LC			X
CAPPARACEAE	<i>Capparis loranthifolia</i>	LC			X
	<i>Capparis umbonata</i>	LC	X	X	X
CARYOPHYLLACEAE	<i>Polycarpaea involucrata</i>	LC			X
CELASTRACEAE	<i>Stackhousia clementii</i>	LC		X	
CLEOMACEAE	<i>Cleome viscosa</i>	LC	X	X	X
COMMELINACEAE	<i>Murdannia graminea</i>	LC			X
CONVOLVULACEAE	<i>Bonamia media</i>	-	X		
	<i>Evolvulus alsinoides</i>	NE	X	X	X
	<i>Ipomoea costata</i>	LC	X		X
	<i>Ipomoea muelleri</i>	LC			X
CUCURBITACEAE	<i>Cucumis argenteus</i>	-	X		
	<i>Cucumis maderaspatanus</i>	LC		X	X
CYPERACEAE	<i>Cyperus cunninghamii</i>	LC			X
	<i>Cyperus dactyloides</i>	LC			X
	<i>Cyperus microcephalus</i>	LC			X
	<i>Fimbristylis dichotoma</i>	LC	X	X	X
	<i>Fimbristylis littoralis</i>	LC		X	
	<i>Fimbristylis nuda</i>	LC			X
	<i>Fimbristylis caespitosa</i>	LC	X		
	<i>Fimbristylis eremophila</i>	LC	X		
<i>Fimbristylis oxystachya</i>	LC	X			
DROSERACEAE	<i>Drosera indica</i>	LC			X

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
ELATINACEAE	<i>Bergia henshallii</i>	LC		X	
	<i>Bergia perennis</i> subsp. <i>perennis</i>	LC		X	X
	<i>Bergia trimera</i>	LC			X
EUPHORBIACEAE	<i>Euphorbia alsiniflora</i>	LC			X
	<i>Euphorbia australis</i>	LC			X
	<i>Euphorbia drummondii</i>	LC			X
	<i>Euphorbia</i> sp.	-	X		
	<i>Euphorbia tannensis</i>	LC			X
	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>	LC		X	X
FABACEAE	<i>Acacia abbreviata</i>	NT	X		X
	<i>Acacia acradenia</i>	LC	X		X
	<i>Acacia adoxa</i>	-	X	X	X
	<i>Acacia adsurgens</i>	LC	X	X	X
	<i>Acacia ancistrocarpa</i>	LC	X	X	X
	<i>Acacia aneura</i>	-	X	X	X
	<i>Acacia bivenosa</i>	LC			X
	<i>Acacia chippendalei</i>	LC	X		
	<i>Acacia colei</i>	-			X
	<i>Acacia conspersa</i>	LC			X
	<i>Acacia cowleana</i>	LC			X
	<i>Acacia cuthbertsonii</i>	LC	X	X	X
	<i>Acacia elachantha</i>	LC	X		
	<i>Acacia hemignosta</i>	LC			X
	<i>Acacia hilliana</i>	LC		X	X
	<i>Acacia holosericea</i>	LC	X		X
	<i>Acacia inaequilatera</i>	LC			X
	<i>Acacia ligulata</i>	LC			X
	<i>Acacia lysiphloia</i>	LC	X	X	X
	<i>Acacia maconochieana</i>	DD			X
	<i>Acacia maitlandii</i>	LC	X		
	<i>Acacia melleodora</i>	LC			X
	<i>Acacia minutifolia</i>	LC	X		X
	<i>Acacia monticola</i>	LC			X
	<i>Acacia orthocarpa</i>	LC			X
	<i>Acacia pruinocarpa</i>	LC			X
	<i>Acacia sericophylla</i>	LC	X	X	X
	<i>Acacia</i> sp.	-	X		
	<i>Acacia stellaticeps</i>	DD			X
	<i>Acacia stipuligera</i>	LC	X	X	X
	<i>Acacia tenuissima</i>	LC	X	X	X
	<i>Acacia tumida</i>	LC			X
<i>Acacia wiseana</i>	LC			X	
<i>Crotalaria novae-hollandiae</i>	LC			X	
<i>Cullen balsamicum</i>	LC			X	

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
	<i>Cullen leucanthum</i>	LC			X
	<i>Cullen martinii</i>	LC			X
	<i>Desmodium muelleri</i>	LC			X
	<i>Erythrina vespertilio</i>	LC			X
	<i>Gastrolobium grandiflorum</i>	LC			X
	<i>Glycine pullenii</i>	LC			X
	<i>Indigofera georgei</i>	LC	X	X	X
	<i>Indigofera linifolia</i>	LC			X
	<i>Indigofera linnaei</i>	LC	X		
	<i>Jacksonia aculeata</i>	DD			X
	<i>Leptosema anomalum</i>	LC	X	X	
	<i>Leptosema chambersii</i>	LC			X
	<i>Mirbelia viminalis</i>	LC	X	X	
	<i>Petalostylis cassioides</i>	LC			X
	<i>Senna artemisioides</i>	LC		X	X
	<i>Senna artemisioides subsp. helmsii</i>	LC		X	
	<i>Senna artemisioides subsp. oligophylla</i>	LC		X	
	<i>Senna artemisioides subsp. quadrifolia</i>	LC		X	
	<i>Senna curvistyla</i>	LC	X		X
	<i>Senna glutinosa</i>	LC	X		
	<i>Senna notabilis</i>	LC	X	X	X
	<i>Senna oligoclada</i>	LC	X	X	
	<i>Senna pleurocarpa</i>	LC			X
	<i>Senna sericea</i>	LC	X		X
	<i>Templetonia hookeri</i>	LC			X
	<i>Tephrosia brachycarpa</i>	LC	X	X	X
	<i>Tephrosia lasiochlaena</i>	LC			X
	<i>Tephrosia leptoclada</i>	LC		X	
	<i>Tephrosia phaeosperma</i>	LC			X
	<i>Tephrosia rosea</i>	NE			X
	<i>Tephrosia supina</i>	LC	X		X
	<i>Vachellia valida</i>	LC			X
	<i>Zornia albiflora</i>	LC	X		
	<i>Zornia muelleriana</i>	DD		X	
FRANKENIACEAE	<i>Frankenia cordata</i>	LC			X
GOODENIACEAE	<i>Brunonia australis</i>	LC	X		X
	<i>Dampiera calostachyus</i>	-	X		
	<i>Dampiera candicans</i>	LC	X		X
	<i>Dampiera cinerea</i>	LC		X	
	<i>Goodenia armitiana</i>	LC	X	X	X
	<i>Goodenia azurea</i>	LC	X	X	X
	<i>Goodenia halophila</i>	DD			X
	<i>Goodenia heterochila</i>	LC			X
	<i>Goodenia triodiophila</i>	LC	X		X

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)	
	<i>Scaevola parvifolia</i>	LC	X	X	X	
	<i>Scaevola spinescens</i>	LC	X		X	
	<i>Velleia connata</i>	LC	X			
GYROSTEMONACEAE	<i>Gyrostemon tepperi</i>	LC			X	
HALORAGACEAE	<i>Gonocarpus eremophilus</i>	LC			X	
	<i>Haloragis gossei</i>	LC			X	
	<i>Haloragis uncatipila</i>	LC	X	X	X	
HYPERICACEAE	<i>Hypericum gramineum</i>	LC			X	
JUNCAGINACEAE	<i>Triglochin hexagona</i>	LC			X	
LAMIACEAE	<i>Dicrastylis exsuccosa</i>	LC			X	
	<i>Newcastelia spodiotricha</i>	LC			X	
LAURACEAE	<i>Cassytha capillaris</i>	LC	X			
LORANTHACEAE	<i>Amyema miquelii</i>	LC			X	
	<i>Lysiana spathulata</i>	LC	X		X	
MALVACEAE	<i>Abutilon leucopetalum</i>	LC		X	X	
	<i>Abutilon macrum</i>	LC	X	X		
	<i>Abutilon otocarpum</i>	LC	X		X	
	<i>Corchorus sidoides</i>	LC		X		
	<i>Corchorus sidoides subsp. vermicularis</i>	LC		X	X	
	<i>Gossypium australe</i>	LC	X	X	X	
	<i>Gossypium bickii</i>	LC			X	
	<i>Hibiscus leptocladus</i>	LC		X		
	<i>Hibiscus sturtii</i>	LC	X	X		
	<i>Keraudrenia nephrosperma</i>	LC	X			
	<i>Lawrenzia glomerata</i>	LC			X	
	<i>Rulingia loxophylla</i>	LC			X	
	<i>Sida A86753 Pindan</i>	LC			X	
	<i>Sida arenicola</i>	LC			X	
	<i>Sida brachypoda</i>	LC	X			
	<i>Sida calyxhymenia</i>	NT				X
	<i>Sida cardiophylla</i>	LC			X	X
	<i>Sida fibulifera</i>	LC			X	X
	<i>Sida filiformis</i>	LC	X	X	X	X
	<i>Sida laevis</i>	LC			X	
	<i>Sida macropoda</i>	LC			X	X
	<i>Sida platycalyx</i>	LC				X
	<i>Sida sp.</i>	-		X	X	
	<i>Sida trichopoda</i>	LC				X
	<i>Triumfetta centralis</i>	LC				X
	<i>Triumfetta johnstonii</i>	LC				X
	<i>Triumfetta winneckiana</i>	LC			X	
MELIACEAE	<i>Owenia reticulata</i>	LC			X	
MENISPERMACEAE	<i>Tinospora smilacina</i>	LC	X	X	X	
MOLLUGINACEAE	<i>Mollugo cerviana</i>	LC			X	

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
	<i>Mollugo molluginis</i>	LC	X		X
MYRTACEAE	<i>Calytrix carinata</i>	LC	X		X
	<i>Corymbia aspera</i>	LC		X	
	<i>Corymbia candida</i>	LC	X		X
	<i>Corymbia opaca</i>	LC	X	X	
	<i>Corymbia pachycarpa</i>	LC			X
	<i>Corymbia terminalis</i>	LC			X
	<i>Eucalyptus brevifolia</i>	LC	X	X	X
	<i>Eucalyptus cupularis</i>	NT			X
	<i>Eucalyptus gamophylla</i>	LC	X	X	
	<i>Eucalyptus limitaris</i>	DD	X		
	<i>Eucalyptus odontocarpa</i>	LC		X	X
	<i>Eucalyptus pachyphylla</i>	LC	X		X
	<i>Eucalyptus victrix</i>	LC		X	X
	<i>Melaleuca lasiandra</i>	LC	X		X
	NYCTAGINACEAE	<i>Boerhavia coccinea</i>	LC	X	
<i>Boerhavia sp.</i>		LC	X		
PHYLLANTHACEAE	<i>Phyllanthus maderaspatensis</i>	LC			X
PICRODENDRACEAE	<i>Petalostigma pubescens</i>	LC			X
PLANTAGINACEAE	<i>Stemodia lythrifolia</i>	LC			X
	<i>Stemodia sp. Tanami (P.K. Latz 8218)</i>	LC			X
POACEAE	<i>Amphipogon sericeus</i>	LC	X		X
	<i>Aristida exserta</i>	LC			X
	<i>Aristida holathera</i>	LC	X	X	
	<i>Aristida inaequiglumis</i>	LC	X		X
	<i>Aristida latifolia</i>	LC		X	X
	<i>Aristida pruinosa</i>	LC		X	
	<i>Cenchrus ciliaris</i>	N	X		
	<i>Chloris barbata</i>	N	X		
	<i>Chrysopogon fallax</i>	LC		X	
	<i>Cymbopogon ambiguus</i>	LC			X
	<i>Cymbopogon obtectus</i>	LC	X	X	X
	<i>Cymbopogon procerus</i>	LC			X
	<i>Dactyloctenium radulans</i>	LC	X		
	<i>Digitaria brownii</i>	LC	X	X	X
	<i>Enneapogon avenaceus</i>	LC		X	
	<i>Enneapogon polyphyllus</i>	LC	X		X
	<i>Eragrostis cumingii</i>	LC	X		
	<i>Eragrostis eriopoda</i>	LC	X	X	X
	<i>Eragrostis falcata</i>	LC		X	
	<i>Eragrostis laniflora</i>	LC			X
	<i>Eragrostis olida</i>	LC			X
	<i>Eragrostis setifolia</i>	LC		X	
<i>Eragrostis speciosa</i>	LC			X	

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
	<i>Eriachne aristidea</i>	LC	X	X	X
	<i>Eriachne helmsii</i>	LC	X		
	<i>Eriachne mucronata</i>	LC		X	
	<i>Eriachne obtusa</i>	LC	X		X
	<i>Eriachne pulchella</i>	DD	X		X
	<i>Eulalia aurea</i>	LC	X	X	X
	<i>Heteropogon contortus</i>	LC			X
	<i>Panicum decompositum</i>	LC	X		
	<i>Paraneurachne muelleri</i>	LC	X	X	X
	<i>Paspalidium rarum</i>	LC	X		X
	<i>Perotis rara</i>	LC			X
	<i>Schizachyrium pseudeulalia</i>	LC			X
	<i>Schizachyrium fragile</i>	LC	X		
	<i>Setaria surgens</i>	LC	X		
	<i>Sorghum plumosum</i>	LC	X		
	<i>Sporobolus australasicus</i>	LC	X		X
	<i>Triodia basedowii</i>	LC	X	X	X
	<i>Triodia bitextura</i>	LC		X	X
	<i>Triodia epactia</i>	LC			X
	<i>Triodia intermedia</i>	LC	X		X
	<i>Triodia pungens</i>	LC	X	X	X
	<i>Triodia schinzii</i>	LC	X	X	X
	<i>Triodia spicata</i>	LC			X
	<i>Uranthoecium truncatum</i>	LC			X
	<i>Urochloa holosericea</i>	LC			X
	<i>Yakirra australiensis</i>	LC	X	X	
PROTEACEAE	<i>Grevillea eriostachya</i>	LC			X
	<i>Grevillea juncifolia</i>	LC			X
	<i>Grevillea refracta</i>	LC			X
	<i>Grevillea wickhamii</i>	LC	X	X	X
	<i>Hakea chordophylla</i>	LC	X		
	<i>Hakea lorea</i>	LC		X	
	<i>Hakea macrocarpa</i>	LC	X	X	X
RUBIACEAE	<i>Dentella pulvinata</i>	NT			X
	<i>Oldenlandia pterospora</i>	LC			X
	<i>Psydrax latifolia</i>	LC			X
	<i>Spermacoce dolichosperma</i>	LC			X
SANTALACEAE	<i>Santalum lanceolatum</i>	LC		X	X
SAPINDACEAE	<i>Diplopeltis stuartii</i>	LC			X
	<i>Dodonaea coriacea</i>	LC	X		X
	<i>Dodonaea lanceolata</i>	LC			X
	<i>Dodonaea viscosa</i>	LC		X	
SCROPHULARIACEAE	<i>Eremophila latrobei</i>	LC	X		X
	<i>Eremophila latrobei subsp. glabra</i>	LC		X	

Family	Scientific Name	N.T. Status	April 2012 (GHD)	May 2013 (EcOz)	NT Atlas (buffer)
	<i>Eremophila longifolia</i>	LC	X	X	
SOLANACEAE	<i>Solanum centrale</i>	LC	X		
	<i>Solanum chippendalei</i>	LC			X
	<i>Solanum diversiflorum</i>	LC		X	X
	<i>Solanum echinatum</i>	LC			X
	<i>Solanum quadriloculatum</i>	LC	X	X	X
STYLIDIACEAE	<i>Stylidium floodii</i>	LC			X
SURIANACEAE	<i>Stylobasium spathulatum</i>	LC		X	X
VERBENACEAE	<i>Clerodendrum floribundum</i>	NE	X	X	X
VIOLACEAE	<i>Hybanthus aurantiacus</i>	LC	X		
ZYGOPHYLLACEAE	<i>Tribulopsis angustifolia</i>	LC	X		
	<i>Tribulus hirsutus</i>	LC			X
	<i>Tribulus sp. saline flats (P.K. Latz 4530)</i>	LC			X
TOTAL spp.	355		131	102	229

Appendix H

Naturalised Weed Species List

Appendix H – Naturalised Weed Species List (DLRM Records for Tanami Bioregion)

Refer to Appendix G for all flora species records for the project area and surrounds. Below outlines the naturalised weed species list.

FAMILY	Scientific Name	Classification	Common name
AIZOACEAE	<i>Trianthema portulacastrum</i>	N	Black Pigweed
AMARANTHACEAE	<i>Aerva javanica</i>	N	Kapok Bush
	<i>Amaranthus viridis</i>	N	Green Amaranth
	<i>Salsola tragus subsp. grandiflora</i>	N	
	<i>Salsola tragus subsp. indeterminate</i>	N	
	<i>Salsola tragus subsp. tragus</i>	N	
ASTERACEAE	<i>Lactuca serriola</i>	N	Prickly Lettuce
	<i>Sonchus oleraceus</i>	N	Common Sowthistle
	<i>Tridax procumbens</i>	N	Tridax Daisy
BRASSICACEAE	<i>Sisymbrium erysimoides</i>	N	Smooth Mustard
	<i>Sisymbrium orientale</i>	N	Indian Hedge Mustard
CUCURBITACEAE	<i>Citrullus colocynthis</i>	N	
	<i>Citrullus lanatus</i>	N	Pie Melon
	<i>Cucumis myriocarpus</i>	N	Prickly Paddy Melon
CYPERACEAE	<i>Cyperus compressus</i>	N	
	<i>Cyperus hamulosus</i>	N	
	<i>Cyperus involucratus</i>	N	
EUPHORBIACEAE	<i>Euphorbia heterophylla</i>	N	
	<i>Euphorbia hirta</i>	N	Asthma Plant
FABACEAE	<i>Alysicarpus ovalifolius</i>	N	
	<i>Indigofera hirsuta</i>	N	Hairy Indigo
	<i>Macroptilium lathyroides var. semierectum</i>	N	
	<i>Stylosanthes hamata</i>	N	Verano Stylo
	<i>Parkinsonia aculeata</i>	B Class; WONS	Parkinsonia
	<i>Senna obtusifolia</i>	B Class	Sicklepod
LAMIACEAE	<i>Hyptis suaveolens</i>	B Class	Hyptis
MALVACEAE	<i>Corchorus olitorius</i>	N	Jute
	<i>Malvastrum americanum</i>	N	Spiked Malvastrum
	<i>Sida acuta</i>	B Class	Sida
ONAGRACEAE	<i>Oenothera stricta subsp. stricta</i>	N	
POACEAE	<i>Avena fatua</i>	N	Wild Oat
	<i>Cenchrus biflorus</i>	N	Buffel Grass
	<i>Cenchrus pennisetiformis</i>	N	
	<i>Cenchrus setiger</i>	N	Birdwood Grass
	<i>Chloris barbata</i>	N	Purpletop Chloris
	<i>Chloris virgata</i>	N	Feathertop Rhodes Grass
	<i>Cynodon dactylon var. dactylon</i>	N	Couch
	<i>Dichanthium annulatum</i>	N	Sheda Grass

FAMILY	Scientific Name	Classification	Common name
	<i>Digitaria bicornis</i>	N	Finger Grass
	<i>Digitaria ciliaris</i>	N	Summer Grass
	<i>Echinochloa colonum</i>	N	
	<i>Eleusine indica</i>	N	Crowsfoot Grass
	<i>Eragrostis amabilis</i>	N	
	<i>Eragrostis cilianensis</i>	N	Stinkgrass
	<i>Eragrostis minor</i>	N	Smaller Stinkgrass
	<i>Setaria verticillata</i>	N	Whorled Pigeon Grass
	<i>Urochloa mosambicensis</i>	N	Sabi Grass
	<i>Cenchrus echinatus</i>	B Class	Mossman Grass
POLYGONACEAE	<i>Acetosa vesicaria</i>	N	
PORTULACACEAE	<i>Portulaca pilosa subsp. indeterminate</i>	N	
SOLANACEAE	<i>Physalis angulata</i>	N	
ZYGOPHYLLACEAE	<i>Tribulus terrestris</i>	B Class	Bindii

Appendix I

Field Photographs – May 2013

Appendix I – Field Photographs, May 2013

Refer to Appendix B for a full species lists for each site. Below are a selection of images taken by field staff from the May 2013 site visit. All photographs are taken by Brendan Schembri and William Riddell.



Brush-tailed Mulgara (*Dasyercus blythi*)



Fat-tailed Pseudantechinus (*Pseudantechinus macdonnellensis*)



Stripe-faced Dunnart (*Sminthopsis macroura*)



Greater Bilby (*Macrotis lagotis*) on camera trap



Leopard Ctenotus (*Ctenotus pantherinus*)



Tanami Ctenotus (*Ctenotus tanamiensis*)



Ridge-tailed Monitor (*Varanus acanthurus*)



Narrow-banded Sand Swimmer (*Eremiascincus fasciolatus*)



Dwarf Bearded Dragon (*Pogona minor*)



Beaked Gecko (*Rhynchoedura ornata*)



Spiny-tailed Gecko (*Strophurus ciliaris*)



Central Netted Dragon (*Ctenophorus nuchalis*)



Black Falcon (*Falco subniger*)



Rufous-crowned Emu-wren (*Stipiturus ruficeps*)



Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)



Zebra Finch (*Taeniopygia guttata*)



Brown Goshawk (*Accipiter fasciatus*)



Brown Falcon (*Falco berigora*)



Dingo (*Canis lupis dingo*)



Red Kangaroo (*Macropus rufus*)