Kimberley Quarry Extension - Ecological Survey Report

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Prepared for: Kimberley Quarry Pty Ltd



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RELIANCE, USES and LIMITATIONS

Executive Summary

Kimberley Quarry Pty Ltd operates the Nillibubbica Quarry approximately 100 kilometres east of Broome, Western Australia.

The company has lodged two clearing permit applications with the WA Department of Mines and Petroleum – CPS 5486/1 and CPS 5565/1. For these applications to be approved, Kimberley Quarry is required to complete a level 1 flora and fauna survey of the proposed cleared areas, and submit a report of the findings.

EcOz Environmental Services was contracted by Kimberley Quarry to undertake the survey and to compile this report of results. A desktop survey was undertaken in May 2013. The field surveys were undertaken in 2013 on June 4 – 6 (all areas except M04/17) and June 25 – 26 (M04/17).

No threatened fauna species were directly observed during the field surveys. However, a group of burrows were located in the centre of the M04/17 lease (Far South). The size and roundness of the entrance, and the density of these burrows, suggests Greater Bilby (*Macrotis lagotis*) burrows. Some disturbance was evident at the entrance of some of the holes; however, no tracks or diggings were seen in the vicinity and it cannot be concluded that any of the burrows were in use by Greater Bilby. The setting of camera traps over burrows that are suspected to be in use by some ground-dwelling animal would assist in determining whether Greater Bilbies are present.

No threatened flora species were found during the field surveys. Some ephemeral species may occur onsite but could not be detected or identified because of the time of year the surveys took place. Three main vegetation associations occur within the surveyed areas.

Weeds were noted only once within the surveyed areas. Signs and/or presence of introduced fauna species were evident at every site; mostly cattle, cat and dog/dingo prints.

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Acknowledgements

Thanks to Jyoti Maggu and Helen Dwyer for assistance with mapping and for supplying comments on the draft, and to Adrian Boyle for assistance with the field work and for supplying comments on the draft. Thanks also to the crew at Nillibubbica Quarry for their hospitality, especially Jeff and Rob.

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1 Introduction

1.1 Context

Kimberley Quarry Pty Ltd operates the Nillibubbica Quarry approximately 100 kilometres east of Broome, Western Australia.

The company proposes expanding the quarry and is investigating a number of options. The potential sites are shown in Figure 1-1, and are referred to throughout this report as:

- East – for the gravel pit within M04/215.
- North 1, 2 and 3 – for the work area, haul road and resource sections that are within M04/75 and the northern section of M04/69.
- South – for the work area in the southern section of M04/69.
- Far South – for the entire area of M04/17.

1.2 Purpose

Kimberley Quarry has lodged two clearing permit applications with the WA Department of Mines and Petroleum – CPS 5486/1 and CPS 5565/1. For these applications to be approved, Kimberley Quarry is required to complete a level 1 flora and fauna survey of the proposed cleared areas, and submit a report of the findings.

EcOz Environmental Services was contracted by Kimberley Quarry to undertake the survey and to compile this report of results. Although not contained within either of the abovementioned clearing permit applications M04/17 was also pre-emptively surveyed.

1.3 Scope

A Level 1 flora and fauna survey consists of the following:

1. A desktop study to gather background information on the target area. This involves a search of all sources of literature, data and map-based information.
2. A reconnaissance survey to:
    a) Verify the accuracy of the background study.
    b) Further delineate and characterise the flora, the range of vegetation units, the fauna and the faunal assemblages present in the target area.
    c) Identify potential impacts.

This involves field work in the target area by suitably qualified personnel to undertake selective, low intensity sampling of the flora and fauna, and to produce maps and descriptions of vegetation and habitat.

Previous surveys identified one fauna and four flora species of conservation significance to be targeted in the field survey:

- Greater Bilby (*Macrotis lagotis*)
- *Goodenia gloeophylla*
- *Goodenia sepalosa* var. *glandulosa*
- *Triodia acutispicula*
- *Aphyllodium parvifolium*

Another priority flora species – *Nymphoides beaglensis* – has also been recorded in the area; however, this species does not fall within the scope of this survey as it is an aquatic plant and there is not suitable habitat within or adjacent to the proposed cleared area.

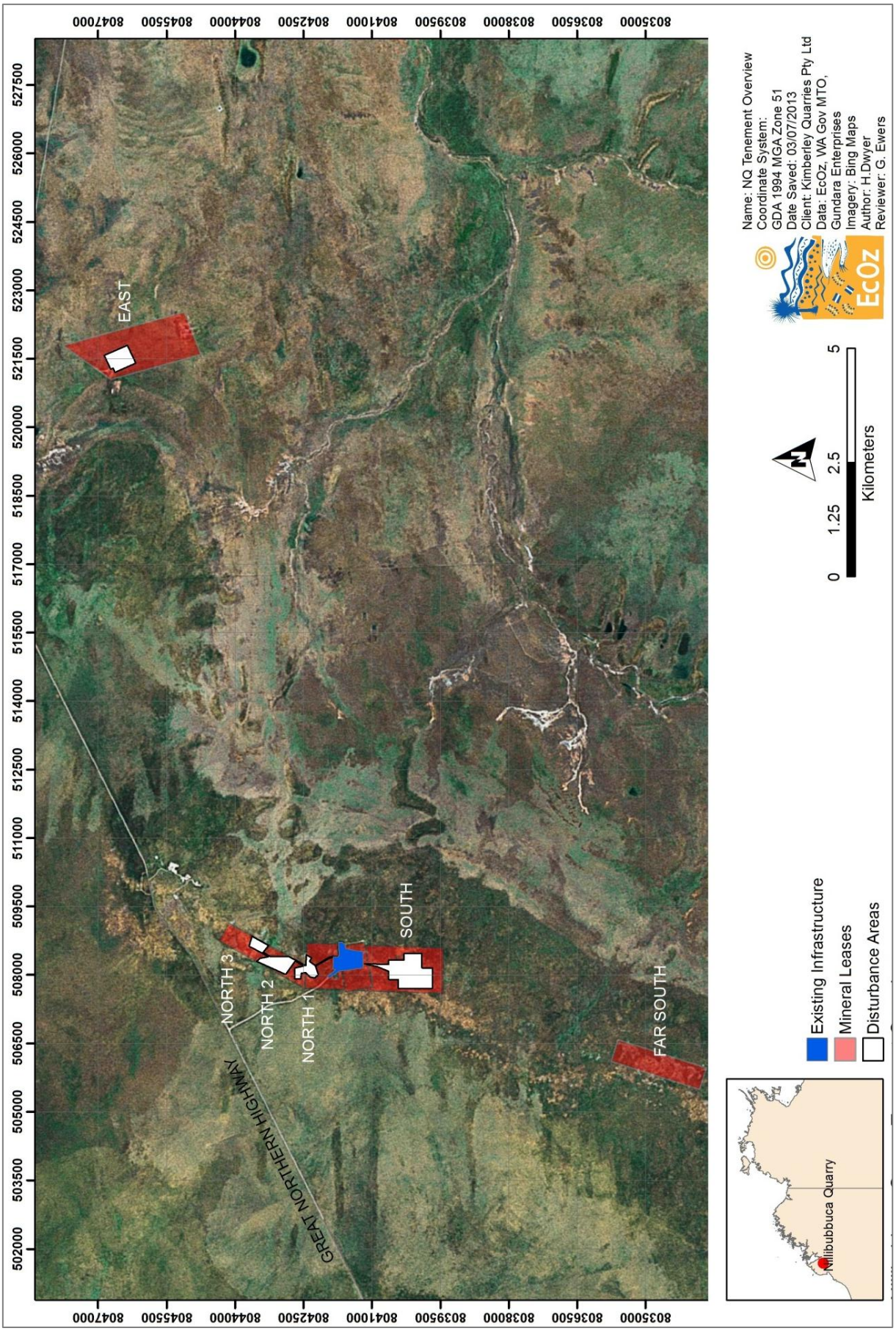

Figure 1-1. Map of site location and overview

2 Background

The 2009 survey reports generated for Kimberley Quarry (by Mattiske Consulting and Ninox Wildlife Consulting respectively) should be referred to for detail on the climate, soils, and topography of the project area.

2.1 Ecology

The project area is located within the Dampier Botanical District of the Northern Province (Beard 1990) as well as the Dampierland IBRA Region, specifically within Dampierland 2. This area is comprised of pindan vegetation on sand plains (Graham 2001). Broad NVIS mapping indicates that the sandstone country containing the project area is Acacia Woodland surrounded by Eucalypt Woodland (see Figure 2-1).

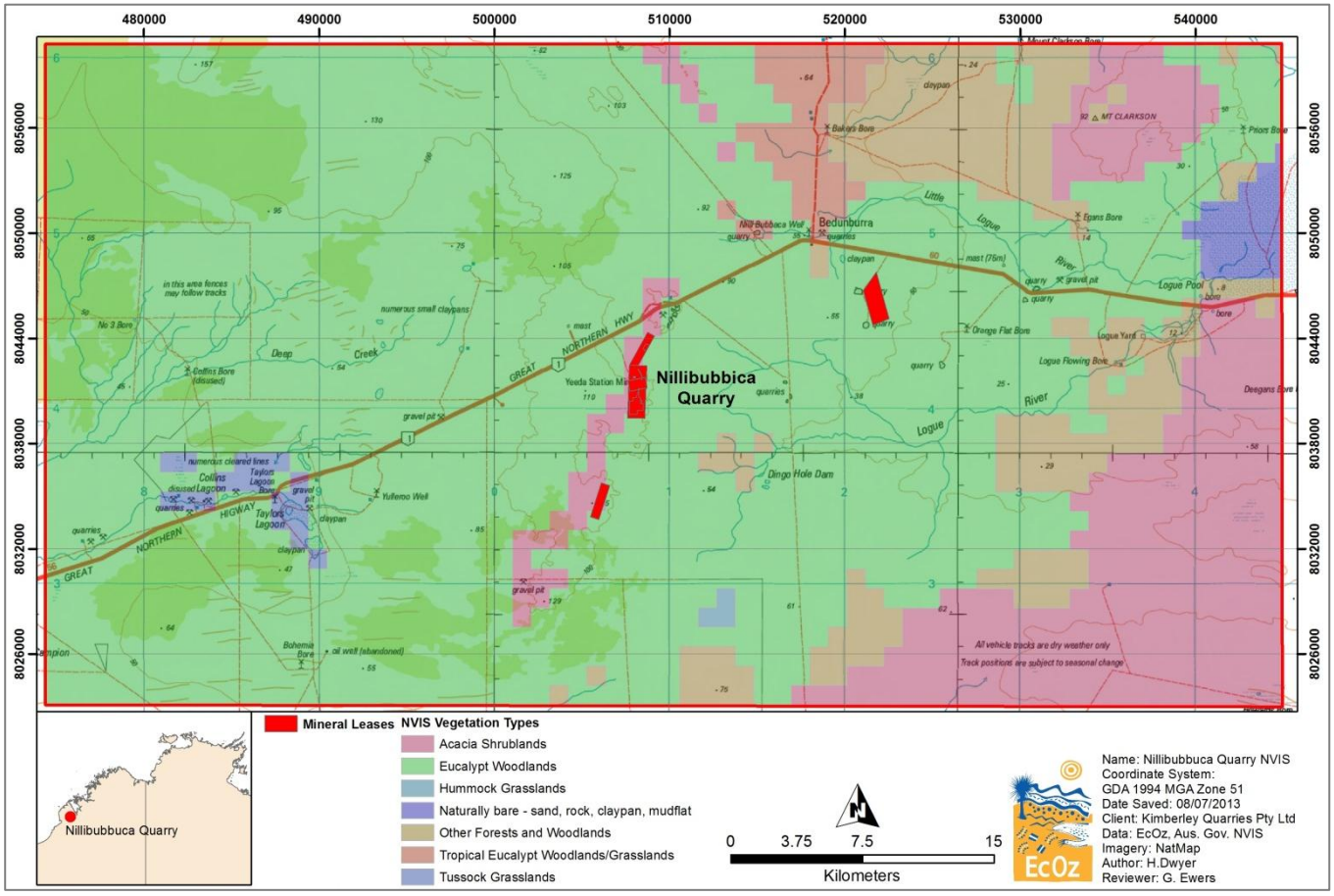

Figure 2-1. Map of broad NVIS vegetation types in the region

Within 40 km of the project site, there are:

- No Threatened or Priority Ecological Communities.
- No records of nationally or state-listed threatened flora species. Two known Declared Rare Flora occur in the Dampierland region, but the range of these species make it unlikely that they will be found in the search area.
- Records of five state-listed priority flora species. (Note that records of priority species in WA have the location generalised to 0.1 degree, and hence cannot be mapped.)
    - *Aphyllodium parvifolium* (Priority 1) which is only known from three locations, two on the coast of Dampier Peninsula.
    - *Goodenia gloeophylla* (Priority 2) which is only known in WA from one collection – Longini Landing at Kalumburu – and has not been re-found there since. It is possible this is a mis-labelled Kakadu specimen (pers. comm. Matthew Barrett, BGPA).
    - *Goodenia sepalosa var. glandulosa* (Priority 3) which is common in the area around Willare.
    - *Triodia acutispicula* (Priority 3) which is a complex species. Many of the previous records of this species from the Dampier Peninsula are actually the recently described *Triodia caelestialis* (pers. comm. Matthew Barrett, BGPA).
    - *Nymphoides beaglensis* (Priority 2) – an aquatic plant.
- Three records of fauna species of conservation significance (not including migratory species) – Painted Snipe (*Rostratula australis*) from the permanent lakes to the west of the site, Greater Bilby (*Macrotis lagotis*) and Bush Stone-curlew (*Burhinus grallarius*).
- Potentially suitable habitat for twenty-one fauna species of conservation significance. However, many of these species have not been recorded in the vicinity.

A recent fauna survey (Astron 2012) found possible evidence of Greater Bilby (*Macrotis lagotis*) presence within the project area. This species is listed as Vulnerable nationally, and as a Schedule 1 threatened species in WA.

3 Methodology

3.1 Desktop survey

A desktop survey using was undertaken in May 2013 using the following databases:

- EPBC Act Protected Matters Search Tool (http://www.environment.gov.au/epbc/pmst/index.html)
- DEC FloraBase (http://florabase.dec.wa.gov.au/)
- DEC NatureMap (http://naturemap.dec.wa.gov.au/default.aspx)
- Atlas of Living Australia (http://www.ala.org)

For each database a 40 km radius search area centred on the existing quarry (-17.714°, 123.078°) was used.

Three desktop surveys previously undertaken were also reviewed:

- Mattiske Consulting (2009) – a desktop flora survey for M04/17, M04/69, M04/75.
- Ninox Wildlife Consulting (2009) – a desktop fauna survey for M04/17, M04/69, M04/75.
- Astron Environmental Services (2012) –a desktop survey for M04/21 and part of M04/69.

3.2 Field surveys

The field surveys were undertaken in 2013 on June 4 – 6 (all areas except M04/17) and June 25 – 26 (M04/17). The region had experienced unseasonably high rainfall (>100 mm) in May, and weather conditions during the first survey were overcast on the first day, with patchy rain on the second. The second survey was undertaken in similar conditions. Further rainfall, approximately 150 mm, fell between the two surveys; most of this was on 6 June.

A substantial area of South and part of Far South had experienced a recent fire; however, there was sufficient unburnt habitat within the proposed cleared areas to identify the flora species present.

The field survey was undertaken in accordance with the requirements for a level 1 flora survey outlined in the Environmental Protection Authority's (EPA) *Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (2004a) and EPA *Guidance Statement 56: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (2004b).

A Scientific or Other Prescribed Purposes (SOPP) Licence to take flora for non-commercial purposes from Crown land and a Regulation 17 Licence to take fauna for scientific purposes were obtained prior to the field survey. The field workers operated under ethics permit number A12005.

3.2.1 Fauna

Two ecologists walked transects across the proposed cleared areas searching for evidence (burrows, diggings or prints) of Greater Bilbies (see Figure 3-1 to Figure 3-4). The locations of suspected diggings from the Astron survey were also visited as a reference. All incidental fauna species present were recorded. A total of approximately 50 kilometres were traversed.

3.2.2 Flora

As well as surveying for Greater Bilbies the two ecologists searched for the four target priority flora species in relevant habitat types. All incidental flora species present were recorded.

Eleven indicative vegetation assessment sites were identified prior to field work. The vegetation and habitat condition was assessed and ground-truthed at each of these using the datasheet in Appendix C.

Figure 3-1. East survey transects and vegetation sites

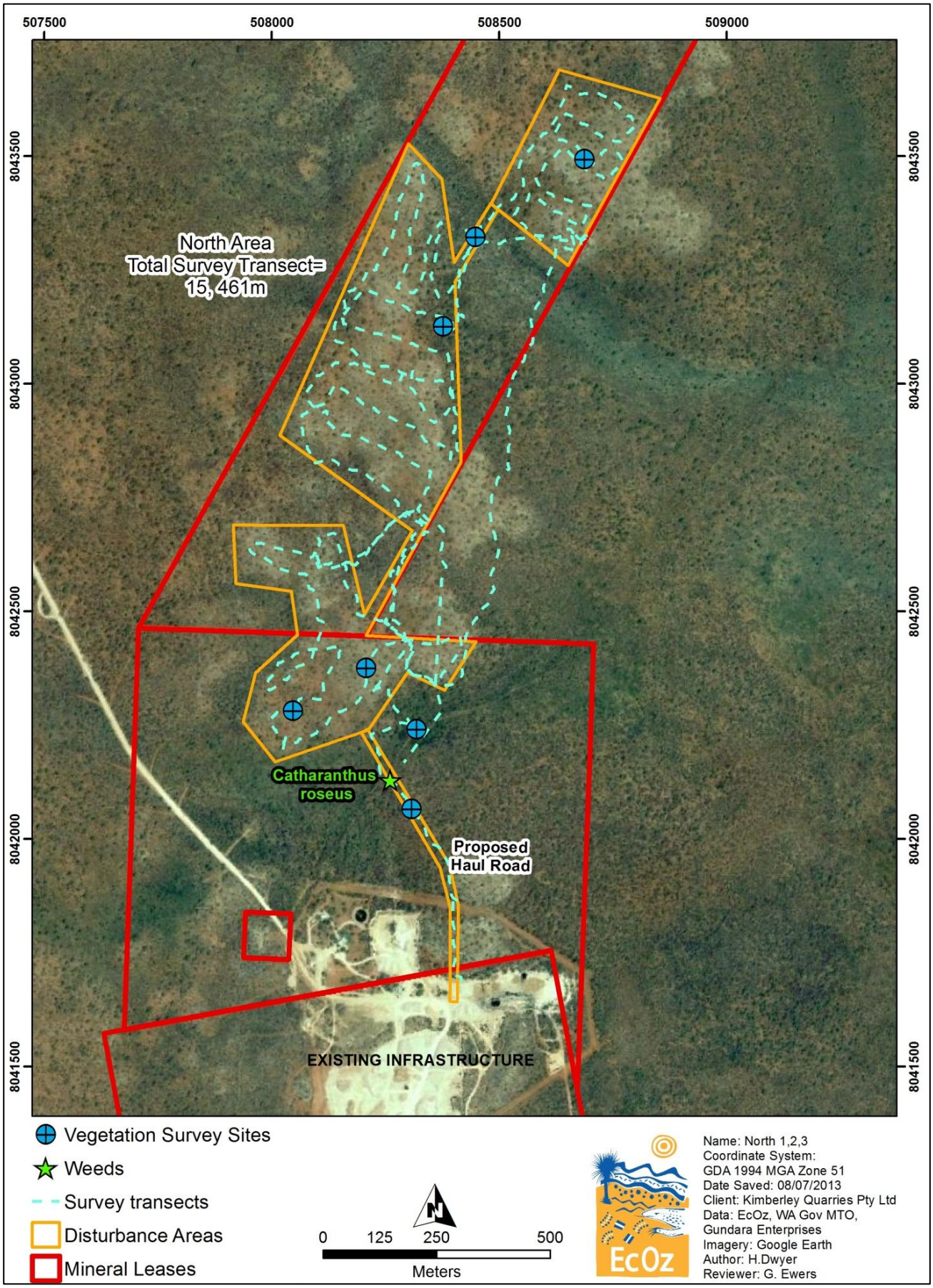

Figure 3-2. North survey transects and vegetation sites

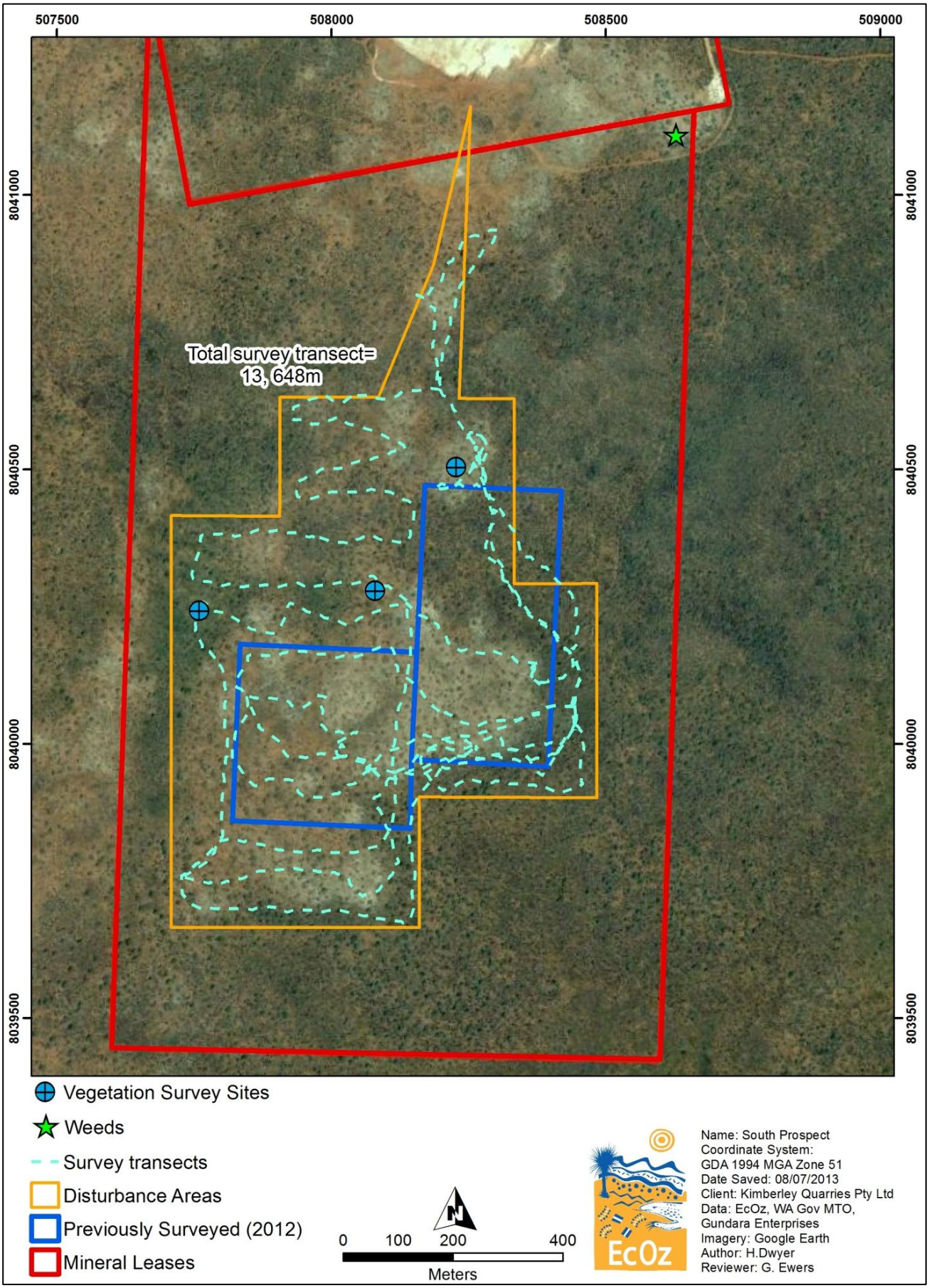

Figure 3-3. South survey transects and vegetation sites

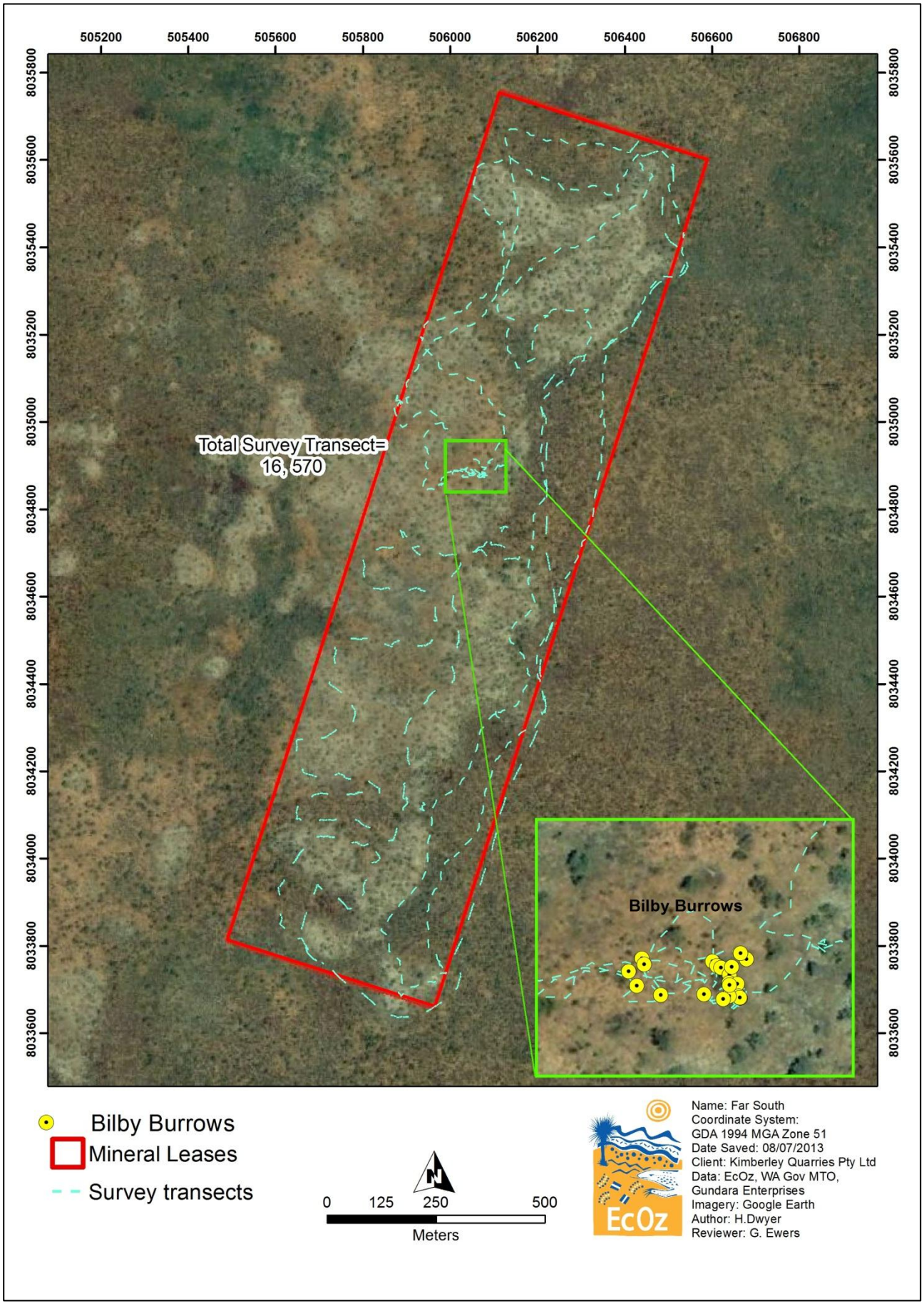

Figure 3-4. Far South survey transects (no vegetation sites)

4 Results

4.1 Fauna

4.1.1 Previous surveys

Desktop fauna study (Ninox Wildlife Consulting 2009) for M04/17, M04/69, M04/75

The search area used by Ninox was not recorded. Their conclusion, based both on records and on current distribution patterns, was that the following could occur in the project area:

- 140 species of bird, the majority seasonal migrants or highly nomadic.
- 37 native mammals, 20 of which are bats.
- 16 species of frog.
- 72 species of reptile.

Of the twenty bird species, five mammals and two reptiles of conservation significance that could occur in the project area, only nine birds and one mammal are likely to be present (i.e. have a moderate to high possibility of occurring) – see Table 4-1.

Table 4-1. Fauna species of conservation significance deemed likely to occur in the project area by Ninox Wildlife Consulting (2009)

Common name	Scientific name	National status	WA status
Australian Bustard	*Ardeotis australis*	-	Priority 4
Barn Swallow	*Hirundo rustica*	Migratory	
Bush Stone-curlew	*Burhinus grallarius*	-	Priority 4
Fork-tailed Swift	*Apus pacificus*	Migratory	-
Grey Falcon	*Falco hypoleucos*	-	Priority 4
Peregrine Falcon	*Falco peregrinus*	-	Schedule 4
Pictorella Mannikin	*Heteromunia pectoralis*	-	Priority 4
Rainbow Bee-eater	*Merops ornatus*	Migratory	-
Red Goshawk*	*Erythrotriorchis radiatus*	Vulnerable	-
Northern Short-tailed Mouse	*Leggadina lakedownensis*	-	Priority 4

*But not suitable habitat and no records for the region

Flora and fauna survey (Astron Environmental Services 2012) for M04/021 and part of M04/69

Both a desktop and Level 1 field survey were undertaken. The search area encompassed the project area and a 20 km buffer for the EPBC Protected Matters search and a 40 km buffer for DEC NatureMap search.

This survey was largely in consensus with the findings of the 2009 fauna survey. It concluded that twenty conservation significant fauna species have been recorded within 40 km of the survey area. Based on habitat preferences, Astron identified eight species of bird and one mammal species as having the potential to occur within the survey area (Table 4-2). This list of species differs from that generated by Ninox Wildlife Consulting – most significantly by the addition of two nationally threatened species, Gouldian Finch and Greater Bilby.

Table 4-2. Fauna species of conservation significance deemed likely to occur in the project area by Astron Environmental Services (2012)

Common name	Scientific name	National status	WA status
Australian Bustard	*Ardeotis australis*	-	Priority 4
Bush Stone-curlew	*Burhinus grallarius*	-	Priority 4
Flock Bronzewing	*Phaps histrionica*	-	Priority 4
Gouldian Finch	*Erythrura gouldiae*	Endangered	-
Grey Falcon	*Falco hypoleucos*	-	Priority 4
Peregrine Falcon	*Falco peregrinus*	-	Schedule 4
Rainbow Bee-eater	*Merops ornatus*	Migratory	-
Red Goshawk	*Erythrotriorchis radiatus*	Vulnerable	-
Greater Bilby	*Macrotis lagotis*	Vulnerable	Schedule 1

- No fauna species of conservation significance were directly recorded within the survey area; however, several diggings were observed in the sandy plains portion of the survey area, the characteristics of which are typical of those made by foraging Greater Bilbies (*Macrotis lagotis*).

4.1.2 Current survey

Desktop search

The desktop search did not reveal any new records of threatened or priority fauna subsequent to the Astron report (2012).

Field surveys

Incidental fauna observations during field surveys included the following:

- Four **amphibian** species were detected (by call, and around the camp only), although no nocturnal searches were undertaken. At least eight additional amphibian species are known from the region.
- **Birds** were in abundance, with 63 species recorded. Almost all bird species expected in pindan woodland were recorded – a notable absence being the normally ubiquitous Bar-shouldered Dove (*Geopelia humeralis*).

  A record of note was four Pictorella Mannikins (*Heteromunia pectoralis*) at the gravel pit site. These are listed as a Priority Four fauna species in WA, meaning they are regarded as rare or near threatened. This observation is at the western extreme of their range. The gravel pit does not represent core habitat for this species. A Bush Stone-curlew (*Burhinis grallarius*) was flushed at Far South. This is also a Priority Four fauna species, but is ubiquitous in pindan country.
- **Mammals** – at every site, macropod scats were recorded. Although only sighted at the dam within the camp, Agile Wallabies (*Macropus agilis*) are common throughout pindan woodland and were recorded by Astron in 2012. An unconfirmed species of macropod was glimpsed – likely a Common Wallaroo / Euro (*Macropus robustus*) (pers. comm. George Swann – local naturalist).
- **Reptiles** – only a few skink species and some Pindan Dragons (*Diporiphora pindan*) were detected. This reflects, most likely, the cool wet conditions. There was evidence of diggings made by monitors.
- Signs of **introduced species** were evident at every site; mostly cattle, cat and dingo prints. Dingoes habituate the area surrounding the camp. Cattle were seen on the southern sites, a cat was recorded at North 3.

A full fauna list is in Appendix A.

Threatened species

No threatened fauna species were directly observed during the field surveys. However, in the centre of the M04/17 lease (Far South), a group of 22 burrows were located within approximately a 0.12 hectare area – see Figure 3-4. The size and roundness of the entrance, and the density of these burrows, suggests Greater Bilby (*Macrotis lagotis*) burrows – Figure 4-1. The burrows were approximately 10 cm in diameter, and dug on a sharp angle into flat sand. The burrows descended straight for approximately 1 metre before dog-legging further into the ground. Greater Bilby burrows often have an adjacent dirt mound created by their excavation; these were mostly washed flat, suggesting the burrows had not been recently dug. Some disturbance was evident at the entrance of some of the holes; however, other mammals, snakes or lizard species also occupy disused burrows and so it cannot be concluded that any of the burrows were in use by Greater Bilby.

Although the surrounding area was covered in cattle prints there were few such prints in the vicinity of the burrows. No Greater Bilby tracks were seen, but this may be due to the crust over the sand from the recent rain. No diggings indicative of Greater Bilbies were found despite searching the surrounding area extensively. A few isolated individual burrows of similar design were located within the Far South area.

The habitat containing the burrows comprised dark red sand with patchy tussock grass, *Sorghum stipoideum*, *Acacia monticola*, *Grevillea refracta* and *Gomphrena canescens* – see Figure 4-2. It was also within the immediate vicinity that the only specimens of *Calandrinia strophiolata* were observed – the significance of this correlation is unclear. It had not been burnt for several years.

Figure 4-1. Photographs of suspected Greater Bilby burrows

Figure 4-2. Photographs of the habitat in which the suspected Greater Bilby burrows were located

Diggings and burrows were generally quite conspicuous throughout the surveys. Burrows with a flat elongated entrance indicative of scorpions (Figure 4-3) or with a dome shape and damaged roof at the entrance indicative of foraging varanoids (Figure 4-4) were commonly observed. Scratchings in the soil were encountered which were not in the tell-tale conical shape of Greater Bilbies and were likely attributable to macropods.

Figure 4-3. Photograph of scorpion burrow

Figure 4-4. Photograph of a varanoid foraging dig

4.2 Flora

4.2.1 Previous surveys

Desktop flora study (Mattiske Consulting 2009) for M04/17, M04/69, M04/75

The search area encompassed the project area with a 20 km buffer.

The conclusion was that three Priority Flora species may occur within the pindan woodland of the search area – *Goodenia gloeophylla* (Priority 2), *Goodenia sepalosa var. glandulosa* (Priority 3) and *Triodia acutispicula* (Priority 3).

The report states that there are records for *Goodenia sepalosa var. glandulosa* within 3 km of the northern section of M04/69 and M04/75. This is not necessarily correct as the location of all threatened priority species records are generalised to 0.1 degrees and so could be upward of 10 kilometres away.

Flora and fauna survey (Astron Environmental Services 2012) for M04/021 and part of M04/69

Both a desktop and Level 1 field survey were undertaken. The search area encompassed the project area and a 20 km buffer for the EPBC Protected Matters search, a 40 km buffer for DEC NatureMap search, and the Dampierland IBRA region for DEC FloraBase.

This survey was largely in consensus with the findings of the Mattiske survey, with the addition of a Priority flora species – *Aphyllodium parvifolium* (Priority 1) – that has been recorded within an extended radius of 40 km from the survey area (the buffer for the 2009 report was 20 km).

4.2.2 Current survey

Desktop search

The desktop search did not reveal any new records of threatened or priority flora subsequent to the Astron report (2012).

Field surveys

Due to the recent rainfall, a number of flora species typically not associated with the dry season – and hence not recorded by Astron (2012) – were present. This included *Cheilanthes caudata* (Rock Fern) on the southern aspects of rock outcrops, *Goodenia sepalosa var. sepalosa* (see below) and *Drosera* sp.

A full flora list is in Appendix B.

Threatened species

No threatened flora species were found during the field surveys. The seed heads of the spinifex growing on the rocky areas had mostly deteriorated making positive identification difficult. *Goodenia sepalosa var. sepalosa* was widespread at all sites (see Figure 4-5); however, none of the specimens had the glandular hairs of the threatened *Goodenia sepalosa var. glandulosa*.

Figure 4-5. Photograph of *Goodenia sepalosa var. sepalosa*

Vegetation associations

Astron (2012) identified three vegetation associations in the survey area, coining them:

- **Sandstone outcrops**: *Corymbia dendromerinx* low woodland over *Terminalia canescens* low open woodland over *Acacia monticola, Grevillea refracta* and *G. pyramidalis* subsp. *pyramidalis* tall open shrubland over *Triodia schinzii* open hummock grassland.
- **Pindan plain open**: *Corymbia polycarpa* low woodland over *Acacia tumida* var. *tumida, A. platycarpa* and *Erythrophleum chlorostachys* low woodland over *Chrysopogon pallidus, Eriachne obtusa* and *Sorghum stipoideum* tussock grassland to closed tussock grassland.
- **Pindan plain dense**: *Corymbia dendromerinx, C. polycarpa* and *Erythrophleum chlorostachys* low open woodland over *Acacia platycarpa* and *A. tumida* var. *tumida* low woodland over *Eriachne obtusa, Aristida holathera* and *Sorghum stipoideum* tussock grassland.

These associations are clearly delineated in the aerial imagery as the pale sandy, orange, and green patches respectively – see Figure 4-6 to Figure 4-9.

In the expanded range of the field surveys undertaken for this report, an additional vegetation association was identified as occurring in the seasonally waterlogged area between North 2 and North 3. This association can be described as follows:

- **Pindan drainage channel**: *Melaleuca viridiflora* and *Acacia tumida* var. *tumida* tall open shrubland over *Chrysopogon pallidus, Eriachne obtusa* and *Sorghum stipoideum* tussock grassland.

The recent field surveys concur with the assessment by Astron (2012) that the vegetation condition across all sites in the survey area are Good to Excellent as per the condition scale developed by Keighery (1994) and Kaesehagen (1994). There were some minor signs of vehicle disturbance, isolated weeds (see below) and evidence of cattle grazing.

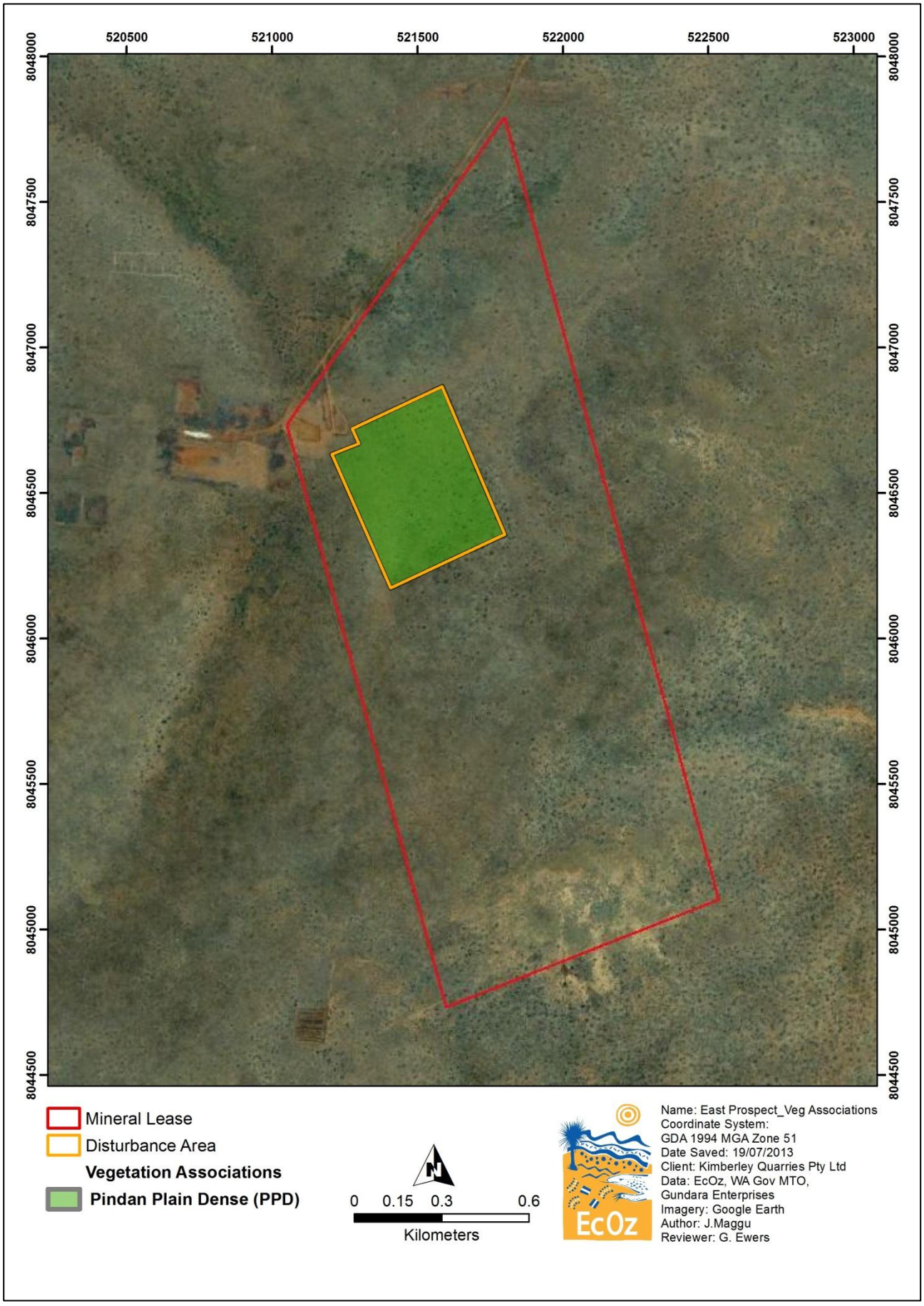

Figure 4-6. Map of vegetation associations for East survey

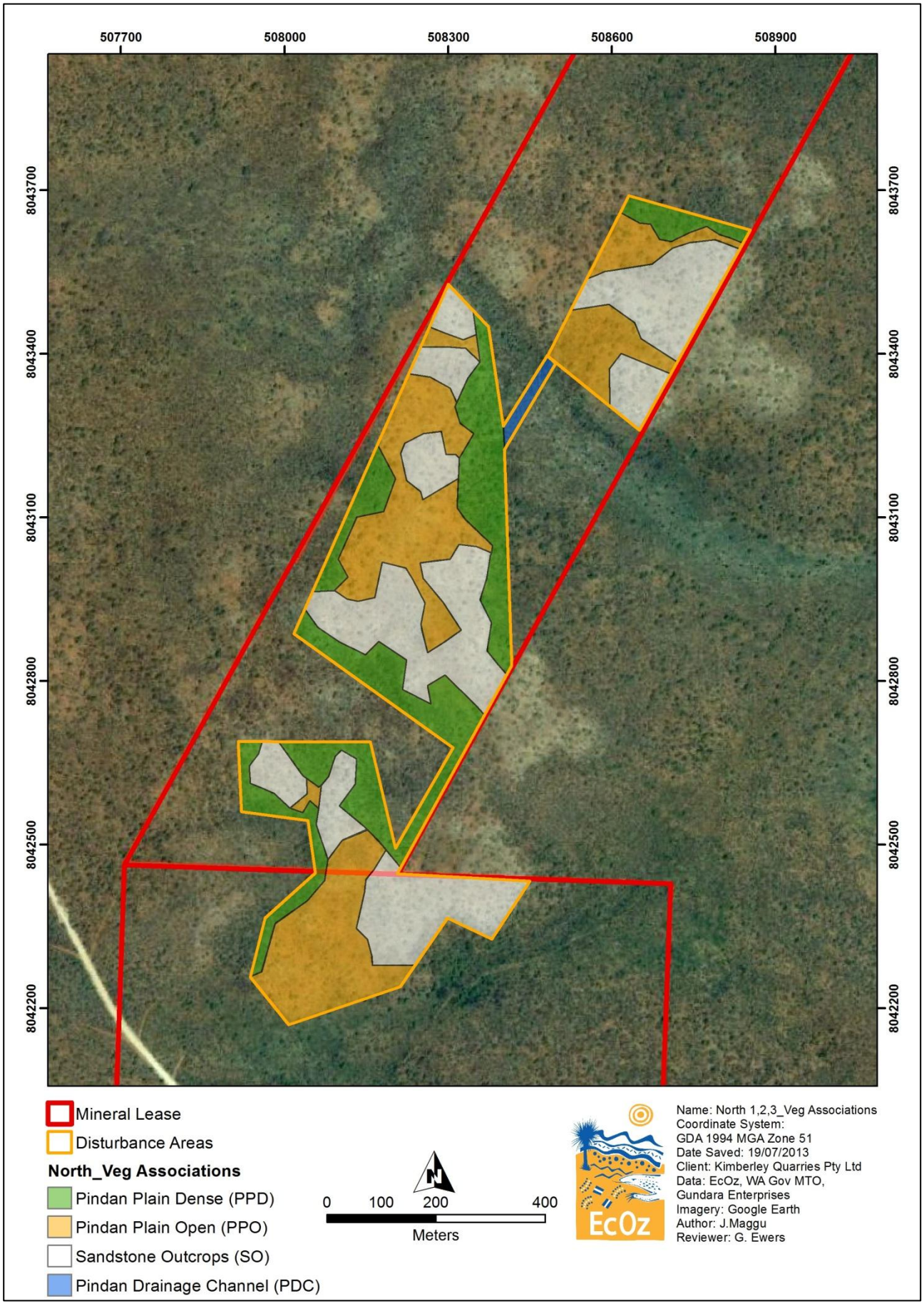

Figure 4-7. Map of vegetation associations for North survey

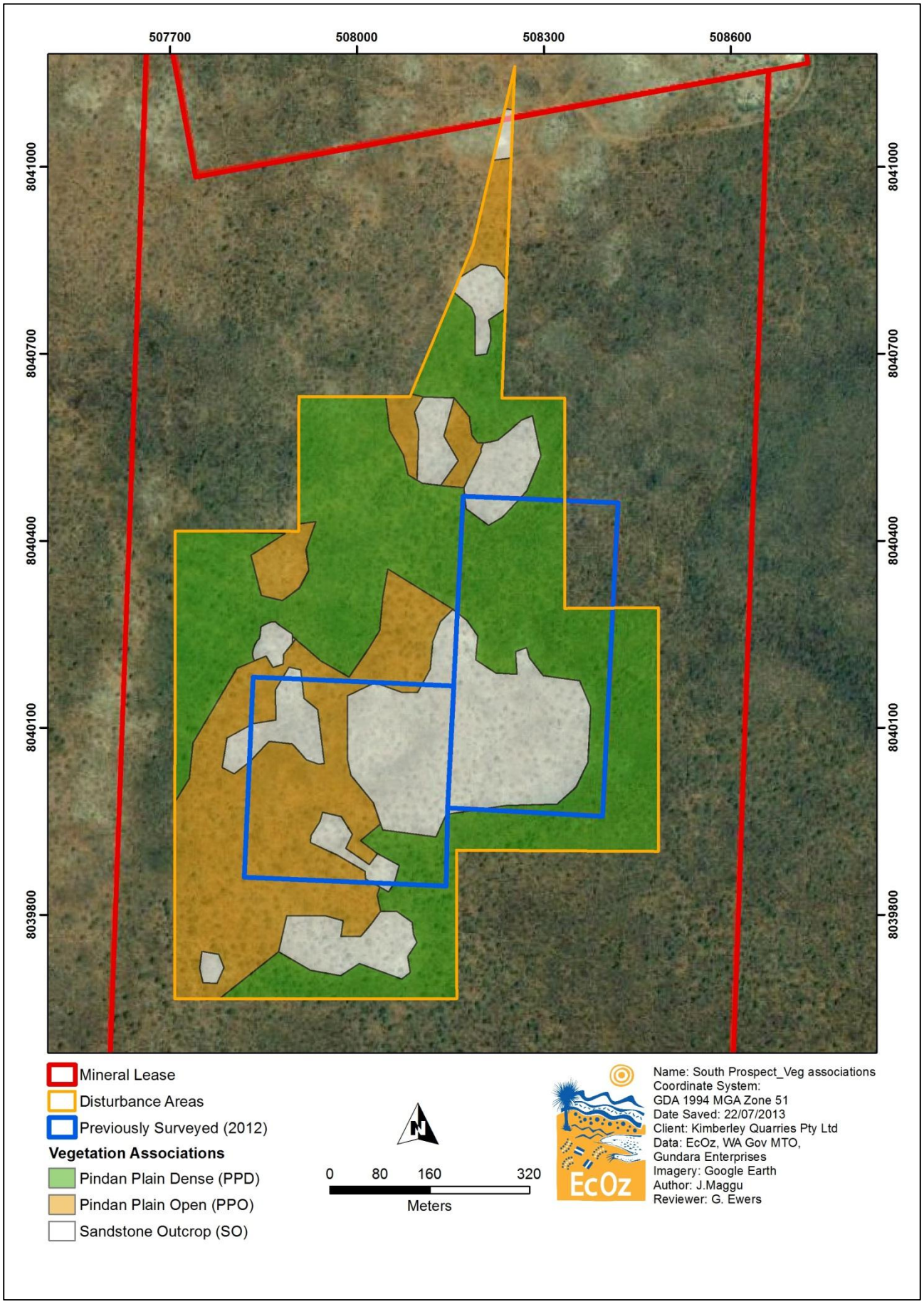

Figure 4-8. Map of vegetation associations for South survey

Figure 4-9. Map of vegetation associations for Far South survey

Weeds

Astron (2012) did not record any weed species during their field work. On a recently cleared track at the northern end of the haul road to the North section, an individual *Catharanthus roseus* (Figure 4-10 and Figure 3-2) was growing. This introduced plant is growing in the camp, including in the garden outside the office. At least two weed species were growing on the rocky outcrop at the camp end of the southern section adjacent to the South –*Tridax procumbens* and *Passiflora foetida* (Wild Passionfruit) – see Figure 3-3.

Figure 4-10. Picture of *Catharanthus roseus* on the haul road survey

5 Discussion

5.1 Fauna

It is likely that the burrows located within the Far South area were created by Greater Bilby – a WA and Commonwealth listed threatened species. There was no evidence that Great Bilbies were currently using the burrows nor were there any signs of foraging diggings in the area. Nevertheless, Greater Bilbies utilise several burrow networks within their range, and may re-visit this area when food resources are plentiful. Therefore, camera trap surveys need to be deployed prior to land clearing to ensure that Greater Bilbies are not present in burrows. Flexible camera rods can also be used to inspect burrows during the day.

5.2 Flora

No threatened flora species were recorded within the surveyed areas. Some ephemeral species may occur onsite but could not be detected or identified because of the time of year the surveys took place.

Weed species occurring on the disturbed areas adjacent to the surveyed areas will likely encroach once clearing takes place if mitigation measures are not put in place.

5.3 *EP Act* clearing principles

Under section 51O of the *Environment Protection Act 1986* (WA), ten clearing principles must be considered by authorities when deciding to grant, or refuse, a native vegetation clearing permit. These are:

> *(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.*
>
> *(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.*
>
> *(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.*
>
> *(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.*
>
> *(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.*

The surveyed areas predominantly comprise pindan woodland, an extensive habitat within the bioregion. Apart from the suspected Greater Bilby burrows, the flora and fauna species recorded during field work are consistent with those commonly recorded in pindan country.

The sandstone outcrops within the survey areas are a less common feature scattered throughout the region that could theoretically present refuges for rare flora and fauna. However, no rare flora or fauna have been detected, which is likely due to fact that the small and isolated habitat patches provide little protection from fire or stochastic events.

> *(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.*
>
> *(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.*
>
> *(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.*
>
> *(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.*
>
> *(j) Native vegetation should not be cleared the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding*

Within the context of native flora and fauna, none of these clearing principles appear to be relevant.

6 References

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Appendix A – Fauna list

Birds

Brown Quail	*Coturnix ypsilophora*
Crested Pigeon	*Ocyphaps lophotes*
Diamond Dove	*Geopelia cuneata*
Peaceful Dove	*Geopelia striata*
Tawny Frogmouth	*Podargus strigoides*
Straw-necked Ibis	*Threskiornis spinicollis*
Whistling Kite	*Haliastur sphenurus*
Black Kite	*Milvus migrans*
Collared Sparrowhawk	*Accipiter cirrocephalus*
Spotted Harrier	*Circus assimilis*
Nankeen Kestrel	*Falco cenchroides*
Brown Falcon	*Falco berigora*
Australian Hobby	*Falco longipennis*
Little Button-quail	*Turnix velox*
Brolga	*Grus rubicunda*
Bush Stone-curlew	*Burhinus grallarius*
Red-tailed Black-Cockatoo	*Calyptorhynchus banksii*
Galah	*Eolophus roseicapillus*
Little Corella	*Cacatua sanguinea*
Cockatiel	*Nymphicus hollandicus*
Rainbow Lorikeet	*Trichoglossus haematodus*
Red-winged Parrot	*Aprosmictus erythropterus*
Budgerigar	*Melopsittacus undulatus*
Pheasant Coucal	*Centropus phasianinus*
Horsfield's Bronze-Cuckoo	*Chalcites basalis*
Pallid Cuckoo	*Cacomantis pallidus*
Southern Boobook	*Ninox novaeseelandiae*
Blue-winged Kookaburra	*Dacelo leachii*
Red-backed Kingfisher	*Todiramphus pyrrhopygius*
Rainbow Bee-eater	*Merops ornatus*
Great Bowerbird	*Ptilonorhynchus nuchalis*
Red-backed Fairy-wren	*Malurus melanocephalus*
Weebill	*Smicrornis brevirostris*
White-throated Gerygone	*Gerygone olivacea*
Striated Pardalote	*Pardalotus striatus*
Singing Honeyeater	*Lichenostomus virescens*
Yellow-tinted Honeyeater	*Lichenostomus flavescens*
Brown Honeyeater	*Lichmera indistincta*
Black-chinned Honeyeater	*Melithreptus gularis*
White-throated Honeyeater	*Melithreptus albogularis*
Little Friarbird	*Philemon citreogularis*
Grey-crowned Babbler	*Pomatostomus temporalis*
Varied Sittella	*Daphoenositta chrysoptera*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
White-winged Triller	*Lalage sueurii*
Rufous Whistler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Olive-backed Oriole	*Oriolus sagittatus*
White-breasted Woodswallow	*Artamus leucorynchus*

Masked Woodswallow	*Artamus personatus*
Black-faced Woodswallow	*Artamus cinereus*
Little Woodswallow	*Artamus minor*
Pied Butcherbird	*Cracticus nigrogularis*
Willie Wagtail	*Rhipidura leucophrys*
Torresian Crow	*Corvus orru*
Restless Flycatcher	*Myiagra inquieta*
Magpie-lark	*Grallina cyanoleuca*
Jacky Winter	*Microeca fascinans*
Golden-headed Cisticola	*Cisticola exilis*
Tree Martin	*Petrochelidon nigricans*
Mistletoebird	*Dicaeum hirundinaceum*
Long-tailed Finch	*Poephila acuticauda*
Pictorella Mannikin	*Heteromunia pectoralis*

Mammals

Dingo	*Canis lupus*
Cattle	*Bos taurus*
Agile Wallaby	*Macropus agilis*
Euro / Common Wallaroo	*Macropus robustus*
Cat	*Felis catus*

Frogs

Mole Toadlet	*Uperoleia talpa*
Green Tree-frog	*Litoria caerulea*
Desert Tree-frog	*Litoria rubella*
Rocket Frog	*Litoria nasuta*
Roth's Tree-frog	*Litoria rothii*

All frogs were identified from call and were in the vicinity of the camp only.

Reptiles

Skink sp.	
Pindan Dragon	*Diporiphora pindan*

Appendix B – Flora list

ACANTHACEAE
Dicliptera armata
AMARANTHACEAE
Achyranthes aspera
Gomphrena canescens
Ptilotus corymbosus
Ptilotus lanatus subsp. lanatus
APOCYNACEAE
Carissa lanceolata
Catharanthus roseus
ASTERACEAE
Pterocaulon serrulatum
Pterocaulon sphacelatum
BORAGINACEAE
Heliotropium ovalifolium
BYBLIDACEAE
Byblis filifolia
CARYOPHYLLACEAE
Polycarpaea corymbosa
Polycarpaea longiflora
CLEOMACEAE
Cleome viscosa
Cleome tetrandra
COMBRETACEAE
Terminalia canescens
CONVOLVULACEAE
Evolvulus alsinoides
CUCURBITACEAE
Cucumis maderaspatanus
CYPERACEAE
Bulbostylis barbata
Cyperus conicus
Fimbristylis sp.
DROSERACEAE
Drosera sp.
FABACEAE
Acacia colei
Acacia monticola
Acacia platycarpa
Acacia tumida var. *tumida*
Bauhinia cunninghamii
Cajanus marmoratus
Chamaecrista symonii
Crotalaria medicaginea
Erythrophleum chlorostachys
Glycine tomentella
Rhynchosia minima
Senna costata
Tephrosia remotiflora
Tephrosia simplicifolia
Zornia muelleriana subsp. *congesta*
GOODENIACEAE
Goodenia sepalosa var. *sepalosa*
Velleia panduriformis
HERNANDIACEAE
Gyrocarpus americanus subsp. *pachyphyllus*
LORANTHACEAE
Amyema bifurcata
Lysiana spathulata subsp. *spathulata*
MALVACEAE
Adansonia gregorii
Brachychiton diversifolius subsp. *diversifolius*
Hibiscus sp
Sida rohlenae
Triumfetta albida
Triumfetta plumigera
Waltheria indica
MENISPERMACEAE
Tinospora smilacina
MYRTACEAE
Calytrix exstipulata
Corymbia dendromerinx
Corymbia polycarpa
Corymbia zygophylla
Melaleuca viridiflora
OROBANCHACEAE
Buchnera ramosissima
PHYLLANTHACEAE
Flueggea virosa subsp. *melanthesoides*
POACEAE
Aristida holathera
Brachyachne convergens
Chrysopogon pallidus
Enneapogan sp.
Heteropogon contortus
Schizachyrium fragile
Sorghum stipoideum
Triodia microstachya
Triodia pungens
Triodia schinzii
POLYGALACEAE
Polygala tepperi
PORTULACACEAE
Calandrinia strophiolata
PROTEACEAE
Grevillea pyramidalis subsp. *pyramidalis*
Grevillea refracta
Hakea arborescens
Persoonia falcata
PTERIDACEAE
Cheilanthes caudata
RHAMNACEAE
Ventilago viminalis
RUBIACEAE
Oldenlandia galioides
SANTALACEAE
Santalum lanceolatum
SAPINDACEAE
Atalaya hemiglauca
Dodonaea hispidula
SOLANACEAE
Solanum dioicum
STYLIDIACEAE
Stylidium leptorrhizum

Appendix C – Habitat Description Assessment Sheet

	Vegetation Quadrat Description Datasheet		**Project:**	Page 1 of 2
	Site Name	**Waypoint**	**Date**:	**Recorder:**

Site description:

Location Information

Slope (°):	**Photo numbers (take 4)**	N E	**Datum:**	**Zone:**
Aspect:		S W	**Easting:**	**Northing:**

General Site Description

Landform:	Crest	Hillock	Ridge	Simple slope	Upper slope	**Shape of Patch:**		
Mid-slope	Lower slope	Flat	Open depression	Closed depression (watercourse/gully) (sinkhole/lake)		**Patch size**	<0.4ha	0.04-1ha	1- 5 ha	5-100ha	<100ha	

Soil Drainage Potential	1 = rapidly drained (steep slope/sandy soil) 2 = moderately well drained (occasional seasonal waterlogging) 3 = poorly drained (seasonally waterlogged most years) 4 = very poorly drained (seasonal waterlogging/inundation expected)
Drawing of Patch:	

Disturbance Information

Disturbance 0=no visible impact -> 5= major impact affecting all of site					**Weed density:**	absent	scattered	sparse	common	abundant	dense
Pig damage: 0 1 2 3 4 5	**Cow/Horse/Donkey:** 0 1 2 3 4 5				**Weed extent:**						
Other Disturbances:					**Weed species:**						

Erosion:	Stabilised/ Absent	Partly Stabilised	Active	**Erosion Extent:**	**Type:** wind scald water sheet rill gully tunnel streambank wave	
Fire impact: 0 1 2 3 4 (see defs)	**Last fire:**	very recent	this year	last year	2+ years	unburnt

Geology and Soils

Rock Types	sandstone	siltstone	laterite	limestone	basalt	granite	quartz	other
Rock Size (cm) % area	s pebbles <0.6cm	m pebbles 0.6-2cm	lg pebbles 2-6cm	cobbles 6-20cm	stones 20-60cm	boulders 60-200	lg boulders >200cm	bedrock outcrop:

Soil Depth	Deep	Shallow	Skeletal	**Soil Type:**	Clay	Loam	Sand	Organic	Other:

Soil Colour	Reddish	Reddish Brown	Brown	Orange	Black	Yellow	Yellowish brown	Grayish	Gray	**Soil Photo:**

Vegetation Cover (%):	**Litter Cover (%):**	**Bare Soil Cover (%):**	**Gravel Cover (%):**	**Rock Cover (%):**

Key Habitat Information

Distance to Perm Water	<100m	100 - 300m	300 - 500m	500 - 1000m	>1000m
Tree Hollows	Absent (0)	Scattered (1 - 5)	Common (6 - 10)	Abundant (>10)	Living or Dead
Fallen Logs (>50cm)	Absent (0)	Scattered (1 - 5)	Common (6 - 10)	Abundant (>10)	
Mistletoe	Absent (0)	Scattered (1 - 5)	Common (6 - 10)	Abundant (>10)	
Flowering Plants	Absent (0)	Scattered (1 - 5)	Common (6 - 10)	Abundant (>10)	Type
Litter	Absent (0)	Shallow	Moderate	Deep	Estimated depth (mm)

Density of termite mounds:	Odd	Sparse	Common	Abundant	**Max ht (m):**	**Profile:**	Tower	Dome	Magnetic

Vegetation Structure

Structural Formation (upper storey) (circle one)

Crown Separation Ratio	Overlapping	0 - 0.25	0.25 – 1	1-20	>20
foliage cover (NVIS)	70-100%	30-70%	10-30%	<10%	>0
% cover (NVIS)	>80%	50-80%	20-50%	0.25-20%	<0.25%
Tree 10-30m (Mid High)	Closed Forest	Open Forest	Woodland	Open Woodland	Isolated trees
Tree <11 m (Low)	Closed Forest (incl MVF)	Open forest	Woodland	Open Woodland	Isolated trees
Shrub	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs
Tussock Grassland	Closed T grassland	T Grassland	Open T grassland	Sparse T grassland	Isolated T grasses
Hummock Grassland	Closed H grassland	H Grassland	Open H grassland	Sparse H grassland	Isolated H grasses

Crown Density (%):	**Stratum**	**U1**	U2	**M1**	M2	**G1**	**G2**		
	% cover:								
	height range (m):								
	average height (m):								

Dominant Vegetation Species for each Stratum

Vegetation Mapping: % Cover Estimate and Height Range (m) and Average (for sp < 1% record a = (1-5 plants) b= (5-50 plants) & c = (50 plants)

Biodiversity Habitat Characterisation: dominant species Name or voucher number (>5% cover only)

Strata labels	**Upper U1**	Upper U2	**Mid M1 (shrub)**	M2 (shrub)	**Ground G1 (tallest ground sp)**	**Ground G2**	**if species occurs in multiple strata enter again and record attributes**

Voucher No.	Species	Notes (Photo Id, description, <5% etc)	Strata	% cover	height lower range	height upper range	average height	BA Live / dead
Basal Denisity - Reference and Check sites - only one basal sweep is necessary								
Bitterlich Sweeps		1 sweep centred on the site		Note Multiplier: 0.25 0.5 0.75 1.0				
Total Basal Area (=sum total) x width of wedge hole used/no. of sweeps made =								
for flowers (FL): 0=no plants in flower (FL) or fruits (FR); 1=isolated plants with few flowers; 2=isolated plants with moderate no. of flowers or most plants with few flowers; 3=many plants with moderate no. flowers; 4=most plants with many flowers; 5=all plants with many flowers. Comparable score for fruit (FR)								