2 BIODIVERSITY ADDENDUM

SILVERTON WIND FARM DEVELOPMENTS

Proposed development of

Stage 1, Silverton Wind Farm,

far western New South Wales

Biodiversity Addendum
Final

November 2008

ngh environmental

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Cover photos: Bynoes Prickly Gecko, feral goats and general view of study area

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1 INTRODUCTION

Silverton Wind Farm Developments Pty. Ltd (SWFD) has completed further biodiversity assessments to enable the number of wind turbines in the Stage 1 project approval application to increase from 120 to 289 turbines. In addition to the assessment of these turbine areas an assessment has also been undertaken on additional transmission line routes and substations within the enlarged Stage 1 project approval area.

This Biodiversity Addendum presents the findings of investigations into biodiversity values and likely impacts associated with development within these additional Stage 1 areas (known as Stage 1b & c) of the proposed wind farm at Silverton, near Broken Hill in far western New South Wales. This addendum supports the Biodiversity Assessment for the Stage 1 project application which is now called Stage 1a (**ngh**environmental 2008a). This addendum seeks to avoid duplication and should be read in conjunction with the earlier report. This addendum has been undertaken by **ngh**environmental to support a 'Preferred Project Application' to be submitted to NSW Department of Planning and has been prepared on behalf of the proponent, Silverton Wind Farm Developments Pty Ltd (SWFD).

This Biodiversity Addendum:

- Provides a summarised description of the proposed works within Stage 1b & c
- Identifies and describes the biodiversity values of the subject land, including descriptions of methodologies and results of detailed flora and fauna surveys
- Identifies species and communities of conservation significance which are present or have potential to be present at the subject site, including potential threatened flora and fauna habitat and Endangered Ecological Communities
- Identifies and assesses the significance of the potential impacts and risks associated with the proposed works in relation to biodiversity values
- Assesses the significance of the potential impacts of the proposal on identified threatened species and communities listed in the *Threatened Species Conservation Act 1995* (Assessment of Significance, Appendix D)
- Assesses the significance of the potential impacts of the proposal on Matters of National Environmental Significance listed in the *Environmental Protection Biodiversity Conservation Act 1999*
- Specifically assesses the risks from bladestrike and habitat impacts to bird species at the site (Appendix E)
- Provides a series of recommended mitigation measures designed to reduce risks and minimise the impacts of the development on flora, fauna and ecological communities

This Biodiversity Addendum is intended to meet the assessment requirements under Part 3A of the *Environmental Planning and Assessment Act 1979* and the *Threatened Species Conservation Act 1995*.

Further background information relating to the site and the proposal is contained in the accompanying Environmental Assessment and the initial Biodiversity Assessment (**ngh**environmental 2008a).

1.1 Description of the site

The proposed development site is located on leasehold land within the Barrier Ranges, approximately 25 kilometres north-west of Broken Hill, New South Wales (refer to **ngh**environmental 2008a for details).

The Barrier Ranges form a series of north-east and north-west trending ridges rising up to 300m above the surrounding plains. The geology of the area includes schist and gneiss, intrusive granites, amphibolites and very coarse pegmatites (Morgan & Terrey 1992).

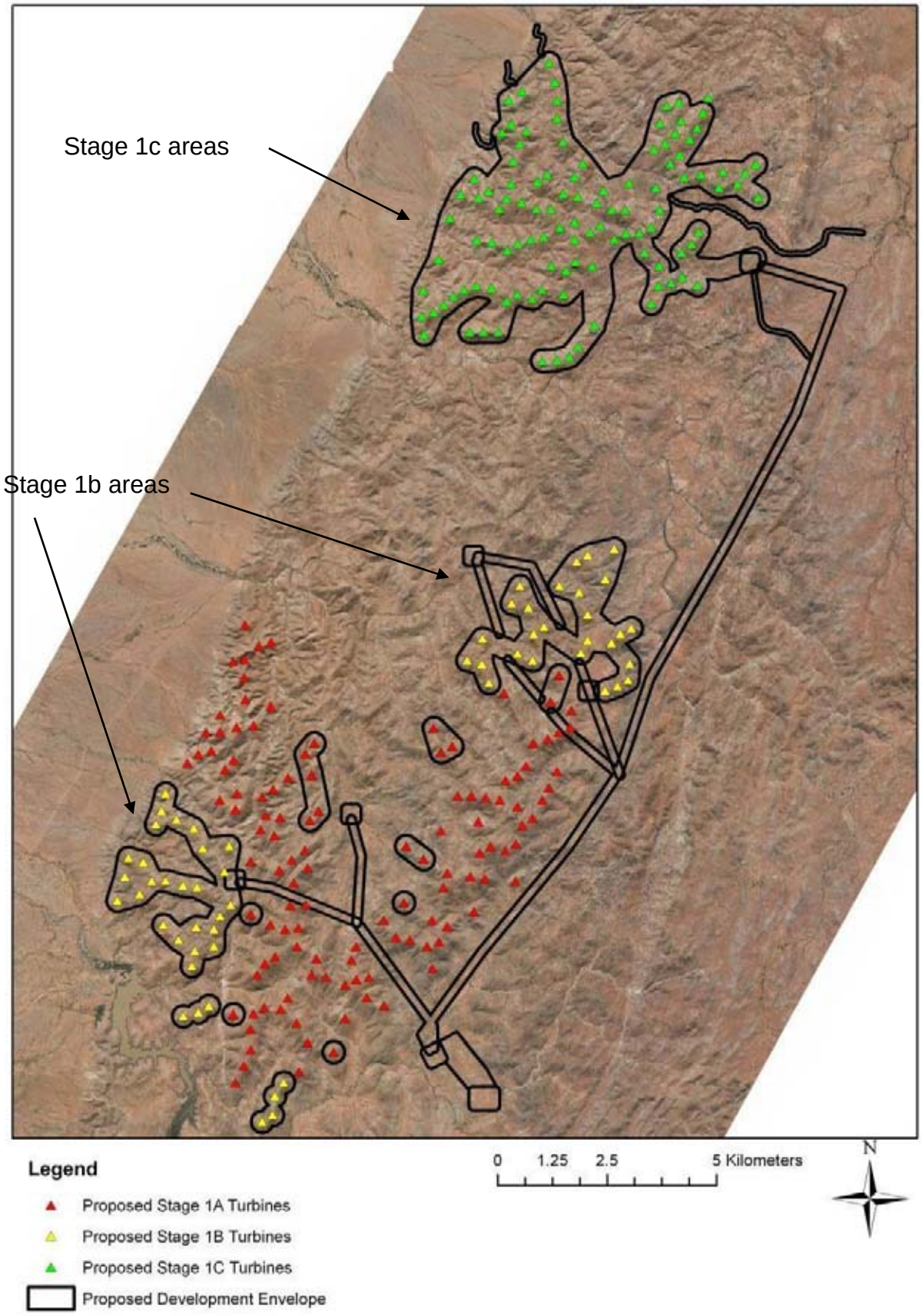
No major watercourses are present, however, several ephemeral watercourses exist within the study area. The first three creeks drain into Umberumberka Dam, which provides part of the water requirements for Broken Hill and Silverton. In some areas, the creeks have formed steep-sided gorges, such as Lords Gorge, where sheltered waterholes exist when water is present. Beyond the Barrier Ranges, the creeks expand as alluvial fans, distributing sediment onto the Mundi Mundi Plain.

1.2 Proposed works

The revised Stage 1 of the proposed Silverton Wind Farm would result in an inclusion of 289 wind turbines instead of 120 (incorporating Stage 1a, the subject of the 2007 surveys, and 1b and 1c, the subject of the 2008 surveys and this report). In relation to these additional turbines there is also a requirement to construct the accompanying transmission lines and substations within the revised development envelope. Two of the substations identified in the concept area of the Environmental Assessment are proposed to be constructed, one in the south of the turbine area, north west of Mount Umberumberka and one in the northern portion of the site, east of the Robe Range. Transmission lines linking these two substations are also proposed to be constructed and are approximately 25 kilometres long. The other transmission line proposed would run from the switch yard to the southern substation and is approximately 8 kilometres long. A map identifying the additional proposed development area is presented (Map 1).

Temporary construction infrastructure will be required during the extended construction and also during the decommissioning phases including concrete batching plant, storage of construction machinery, equipment and materials and site offices.

As with the previous Biodiversity Assessment, this Addendum has been conducted on the basis of a broad development envelope which takes in all of the possible turbine sites and associated access tracks and cabling routes within the development envelopes indicated on Map 1.



Map 1: Proposed additional areas of the Stage 1 development (Stage 1b & 1c)

The areas not assessed as part of the Biodiversity Assessment (nghenvironmental 2008a) are delineated in black – the revised development envelope, encompassing Stages 1b and 1c.

2 METHODOLOGY

The preparation of this Biodiversity Addendum involved desktop research, consultation with people with local and specialist knowledge, fieldwork, data analysis, significance assessment and report compilation. On-ground validation and verification of biodiversity values previously identified in the Stage 1 Biodiversity Assessment were undertaken in the Stage 1b and 1c areas.

2.1 Overview

Information was sourced on threatened species, populations, and communities having potential to be present at the subject site and in the wider study area. A range of reference books, research papers, conference papers, wind farm assessments and web tools and publications were sourced, focusing on relevant species and the study area. Several experts were contacted, and are cited in the relevant sections as well as the Acknowledgements. In addition, government representatives and lessees provided local information.

2.1.1 Analysis, assessment and report compilation

Data collected during fieldwork were analysed to determine threatened species habitat suitability, representation of vegetation types and the significance of potential impacts to biodiversity values present at the proposal site. This report is structured using the conventional values-impacts-significance assessment format, for flora, ecological communities and fauna. Dedicated assessments of significance are presented for threatened species and communities, consistent with NSW and Commonwealth legislative requirements. A specific risk assessment for birds and bats at risk of collision with turbines has also been undertaken, focusing on significant and threatened species. A series of recommended mitigation measures to avoid and reduce impacts on flora and fauna at the site has been developed, based on the identified values and potential impacts.

2.1.2 Fieldwork

Site fieldwork was carried out between 28 August and 4 September 2008. Fieldwork sought to determine if biodiversity attributes and the presence and condition of biodiversity values were comparable to that identified in the Stage 1a Biodiversity Assessment (**ngh**environmental 2008a). Field activities included general broad scale surveys and targeted surveys for threatened species and Endangered Ecological Communities known to be present, or with potential to be present in the area.

Field work focussed on a revised development envelope (including areas additional to that of the Stage 1 study area defined by SWFD); Map 1. The spatial distribution of all survey sites from both the 2007 surveys, and the recent surveys are shown (Map 2). Additionally, large portions of the Stage 1b and 1c areas were walked over, or viewed from adjacent ridges to enable the broader stratification of the study area in terms of habitats and vegetation structure. The wide extent of surveys across the larger study area combined with the majority of the study area being walked over or viewed from adjacent ridges, provide a high level of information on the biodiversity of the locality.

Map 2: The spatial distribution of 2007 and 2008 specific survey sites across the study area

2.2 Flora and vegetation communities

2.2.1 Preliminary assessments

Fieldwork was preceded by a desktop assessment to identify species and communities of conservation significance potentially present in the study area and a review of the previous Biodiversity Assessment undertaken for Stage 1a of the proposed Silverton Wind Farm (**ngh**environmental 2008a). Topographic maps, aerial photographs, previous research and assessments and records contained in national and state databases were sourced to identify known and potential values. Key web-based databases, including the Commonwealth Protected Matters search tool using a 30 kilometre buffer, Bionet and the DECC Wildlife Atlas (based on the Broken Hill local government area and Unincorporated area) were sourced. The DECC Threatened Species Database was also used to assess the habitat potential for threatened species in the Barrier Range sub-region of the Broken Hill Complex Bioregion which have been recorded, or are predicted to occur, based on known ecological relationships (DECC 2007b).

2.2.2 Field survey and mapping

The additions to the Stage 1 development envelope (incorporating Stage 1b and 1c proposed infrastructure and buffers), were surveyed for flora values between the 28th August and the 4th September 2008. The methods and outputs of the assessment are developed to meet the requirements contained in the Draft Guidelines for Threatened Species Assessment (DEC, DPI 2005) and the Working Draft Guidelines for Threatened Biodiversity Survey and Assessment (DEC 2004).

The study area was stratified into broad homogeneous survey zones based on vegetation communities recorded during the previous Biodiversity Assessment (**ngh**environmental 2008a). Any vegetation communities not identified in previous surveys were sought across the study area. In addition, the periphery of existing tracks at the site which may be used during the construction phase of the proposal were examined for significant or sensitive vegetation features that would potentially be impacted by increased traffic load or road improvement works.

A broad-scale vegetation map of the study area was produced with recourse to aerial photograph interpretation and onground validation. Onground flora surveys were undertaken using the 'random meander' method (Cropper 1993), rather than quadrats, to maximise opportunities for detecting significant or sparsely distributed plant species across the additional study area (Map 3). The abundance of each species was also recorded within each vegetation community using an adaptation of the Braun-Blanquet approach (refer to Table 1). Incidental sightings of flora species made during the field survey and while traversing the study area were also recorded. Species recorded during this survey are listed in Appendix A. In addition, dedicated searches in specific habitat areas were undertaken for threatened species which were assessed as having at least a moderate potential to be present at the site (refer Appendix C).

Table 1: Relative abundance ranking employed during the survey

Score	Relative Abundance
5	Very common, usually single species dominant
4	Common, dominance is shared by 2 or 3 other species.
3	Frequent, a species not sharing dominance but remains significant to the composition of the site.
2	Occasional occurrence
1	Rare, individuals infrequently seen

The identification of vegetation types was undertaken using the New South Wales Vegetation Classification and Assessment database and is detailed in Benson (2006) and Benson et al. (2006). These vegetation types are classified primarily on the basis of landscape position and vascular plant structure. This Biodiversity Addendum describes the vegetation communities as detailed by Benson (2006) and Benson et al. (2006).

Botanical nomenclature follows Harden (1990-2001), except where recent taxonomic changes have occurred. Noxious weeds identified are those declared for the Unincorporated control area under the *Noxious Weeds Act 1993*.

Map references locating significant vegetation features and noxious weeds were obtained using a hand-held 12 channel GPS unit, and are based on the GDA datum to mirror aerial imagery that was available for the study area.

2.2.3 Survey limitations

Given the large area of the proposed development area, and uncertainty regarding precise areas of direct impact, a random meander search was undertaken to survey each zone within the survey area.

While a range of environmental variation was covered within each vegetation community, not every part of each community was inspected in fine detail. Rather, a subset of surveys was undertaken within each vegetation community that enabled a broad scale assessment of each community type.

Vegetation mapping was based on a combination of aerial photograph interpretation with some on-ground validation carried out during field work between the 28th August and 4th September 2008. Due to the large area of the proposed development site, not all vegetation boundaries were assessed in detail. Rather, the mapping shown provides an indicative estimate of the extent of vegetation communities across the study area from a combination of aerial photograph interpretation and on-ground validation.

The survey was undertaken in late winter/early spring to coincide with the peak detectability of the majority of ground flora species that are likely to be present from winter rains before they desiccate in the extended heat. This timing means that some annual or geophytic species (such as terrestrial orchids) which flower outside the survey period would not have been recorded. Ephemeral species which flower in response to irregular rainfall or disturbance events such as fire will also have gone unrecorded. In view of this and as a precautionary approach, the known habitat requirements of threatened species which have been recorded or are predicted to occur in the region, have been analysed against the vegetation communities of the study area to evaluate their potential for occurrence. The probability of species of conservation significance having been omitted due to seasonal factors is further discussed in Appendix C and Section 3.1

The subject site is currently grazed by domestic stock (sheep), feral goats and rabbits. This is likely to affect the ability to record some grazing-sensitive species.

2.3 Fauna and fauna habitat

2.3.1 Preliminary assessments

A preliminary assessment of fauna habitat values and the likelihood of threatened fauna species being present was undertaken based on species distribution records and known habitat requirements identified during previous reports in relation to the proposed development (**ngh**environmental 2008a, b). The results of previous fauna survey work in the region were also reviewed for threatened fauna records. Habitat requirements were drawn from a range of sources, including reference books, scientific papers, local research and author experience.

2.3.2 Field surveys and mapping

The fauna survey was carried out for nocturnal and diurnal species over the period 28th August and 3rd September 2008. The survey was intended to provide additional data relevant to the Stage 1b and c areas and to gain a further understanding of the fauna and fauna habitat of the wider study

area. In particular, the surveys focused on rare and threatened species, species protected under international conventions, species which may be dependent on habitat in the study area, large or unusual concentrations of a species and species which may be especially sensitive to wind farm developments.

The following fauna survey techniques were undertaken during the 2008 surveys:

- Bird censuses: targeted bird surveys occurred at 41 sites across the study area for a period of 20 minutes each by two observers including at the nearby Umberumberka Dam. The total survey time was 27.3 hours. Opportunistic sightings of threatened and significant species were also recorded while travelling across the study area
- Habitat assessment, including searches for species signs (scats, runways, feeding signs etc), was undertaken at 37 sites to identify food and shelter resources, limiting or specialised habitat features such as hollows and other features known to be used by the threatened fauna that are known to, or predicted to occur in the study area
- Funnel Trapping targeting small mammals and reptiles occurred at 3 sites across the study area consisting of 6 funnel traps each. At each site, funnel traps were connected by 20 metres of drift fence to divert animals into these traps and each was activated for four days. A total of 36 trap nights was undertaken
- Active searches for herpetofauna were undertaken at 21 sites for a period of 20 minutes at each site, giving a total survey effort of 7 hours.
- Elliot and Cage trapping was also used to target small mammals and reptiles. This occurred at six sites across the study area using 10 Elliot traps and 1 cage trap at each site for three nights. Traps were baited with rolled oats, peanut butter and cat food as an attractant to mammals and reptiles. A total of 198 trap nights were undertaken.
- Microbats were targeted using 'Anabat' ultrasonic call detection recording equipment. This was undertaken at 4 sites across the study area for a period of one night at each site, giving a total survey effort of 4 nights.
- Nocturnal surveys were undertaken at two locations in the study area. These surveys included nocturnal call playback for the threatened Masked and Barking owls and Bush Stone Curlew, listening for calling frogs and spotlighting for fossorial and arboreal fauna (both on foot and in vehicle). Each of the sites was surveyed for a minimum of 40 minutes, giving a minimum survey effort of 80 minutes.
- Opportunistic surveys: incidental records of fauna were collected while traversing the majority of larger ridges of the study area during the onground stratification process. Fauna were also recorded while traversing between survey sites.

The fauna survey effort undertaken is summarised in Table 2 and a visual representation is provided in Map 3. Fauna surveys aim to sample a range of fauna habitat across the study area that has the potential to be directly or indirectly impacted by the proposal, particularly the ridges.

The survey also covered areas in and adjacent to the subject site which have greatest likelihood of providing habitat for threatened fauna, including threatened reptiles, woodland birds and microbats, therefore, increasing the potential of detectability to determine presence in the study area.

Map references locating surveys sites and features of interest were obtained using a hand-held 12 channel GPS unit, and are based on the GDA datum.

2.3.3 Threatened and other significant species

The DECC NSW Atlas of Wildlife database was consulted for records of threatened species and other species of conservation significance in the study area based on the Corona, Fowler's Gap, Broken Hill and Taltingan 1:100,000 map sheet areas.

Other state and national databases were used to identify known and modelled significant fauna species distributions, including Bionet, Commonwealth Protected Matters search tool using a 30

kilometre buffer around the subject site. A list of threatened fauna with potential to occur at the site was compiled to assist the field survey design and species targeted (Appendix C). A precautionary approach has been adopted where distribution and habitat information is incomplete or uncertain.

2.3.4 Survey limitations

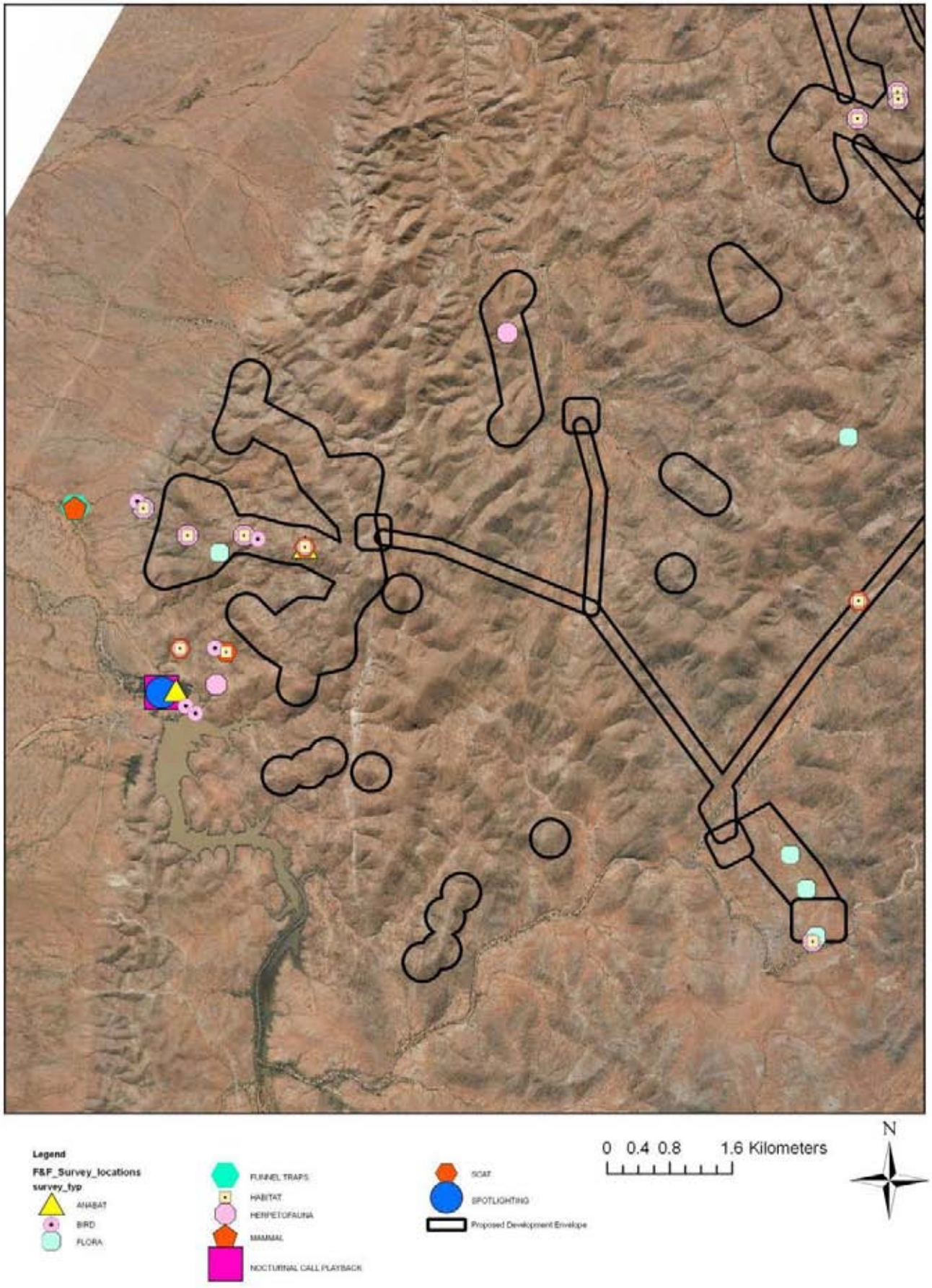
The spring timing of the fauna surveys (August - September 2008), provided cool to mild temperatures that may have limited the maximum detectability of some species such as reptiles and microbats. High winds and cooler temperatures would have also reduced the potential to detect fauna during nocturnal surveys. However, a precautionary approach has been adopted by using the survey data from 2007, and considering the species that are known to, or predicted to occur in the study area.

While not all areas of the proposed development were surveyed with detail, it is considered that with the quality and diversity of habitats at the subject site, the selected survey methods and intensity were appropriate to determining the key biodiversity constraints of the study area and for characterising the potential for impact of species that could occur onsite but went undetected. The surveys, as is normal, are likely to have resulted in the omission of some cryptic, sparsely distributed, ephemeral or seasonal species due to the limited duration and survey timing. For example, during wetter seasons, increased activity is expected in drainage lines within the study area as ephemeral watercourses provide a flush of resources. Accordingly, when assessing fauna habitat, its condition and the potential for threatened species to occur, a precautionary approach has been adopted.

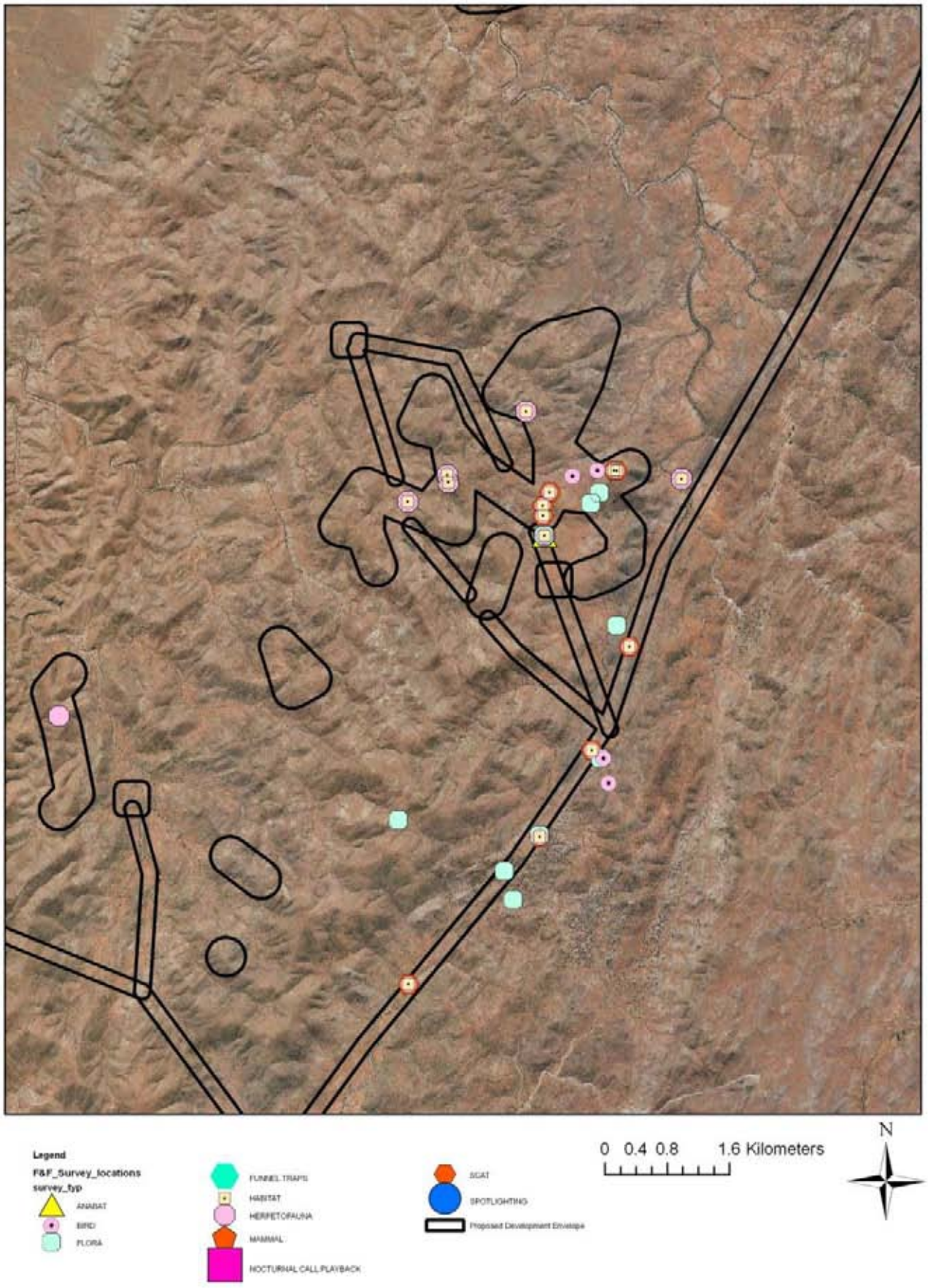
Data from the 2007 fauna surveys across the Stage 1a study area is also included in this Addendum to provide a more complete analysis of the fauna species that could be present across the proposed Stage 1b and 1c areas.

Table 2: Summary of fauna survey effort during this survey

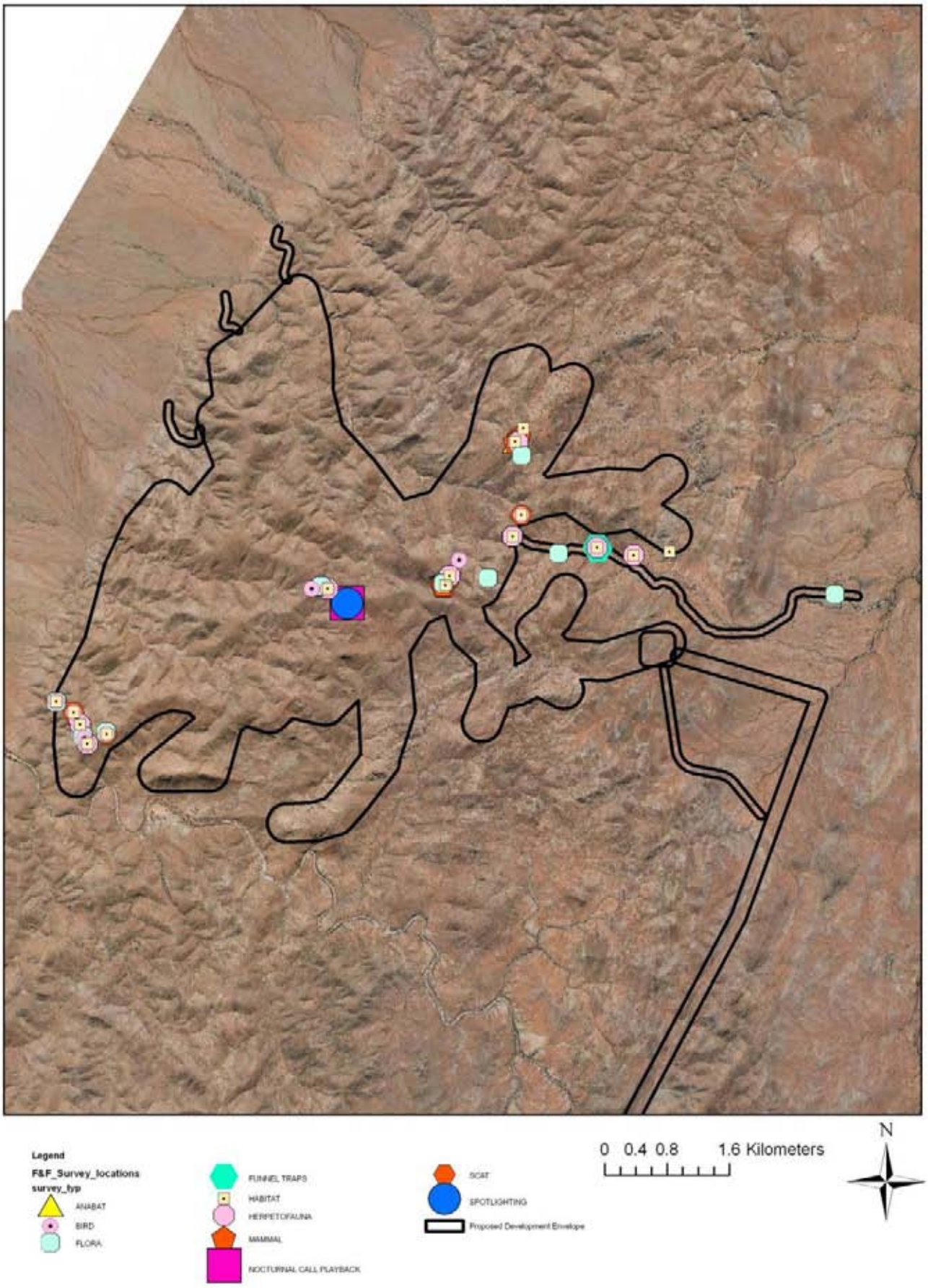
Technique	Target group	No. of sites	Timing	Total survey effort	Other comments
Bird censuses	Diurnal birds	41	20 minutes at each site by two observers	27.3 hours	Opportunistic records also collected while driving between sites and within the general study area and walking the ridges during stratification and overview of the study area
Funnel traps (with interconnecting drift fences)	Reptiles and small, ground dwelling mammals	3	Traps at each site were opened for 4 days	36 trap nights	
Active searches	Reptiles	21	20 minutes at each site	7 hours	Opportunistic records of larger species such as shinglebacks were also collected while driving between sites and within the general study area walking the ridges during stratification and overview of the study area
Elliot and Cage trapping	Small ground dwelling mammals, larger carnivorous mammals, reptiles	6	10 elliot traps and one cage trap at each site for 3 nights.	198 trap nights	
Anabat call detection	Bats	4	1 anabat detector for one night at each site	4 nights	
Nocturnal surveys (call playback, spotlighting)	Nocturnal birds, mammals, reptiles and frogs	2	40 minutes at each site	80 minutes	Opportunistic records while driving between sites using car headlights and spotlighting.
Habitat assessment including searches for species signs (scats, runways, feeding signs etc).	Reptiles, Birds, Mammals, Frogs, Bats	37	Average of 15 minutes at each site, dependant on habitat complexity.	Approx 9 hours	Opportunistic records of all species were collected.



Map 3.1: Locations of fauna and flora survey sites during this study.



Map 3.2: Locations of fauna and flora survey sites during this study.



Map 3.3: Locations of fauna and flora survey sites during this study.

3 RESULTS

3.1 Flora and vegetation communities

3.1.1 Vegetation communities

The previous Biodiversity Assessment undertaken for Stage 1a of the proposed Silverton Wind Farm recorded ten vegetation communities within the proposed development envelope (**ngh**environmental 2008a). Seven of these vegetation communities were also recorded in 2008 in the Stage 1b and 1c development envelope. Additionally, two undescribed vegetation communities were also recorded in Stages 1b and 1c, with nine vegetation communities in total found across the entire development area. The seven communities common to Stage 1a, included:

- Benson Veg ID 123 - Mulga – Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions
- Benson Veg. Comm. ID 136 - Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone
- Benson Veg. Comm. ID 155 - Bluebush shrubland on stony rises and downs of the arid zone
- Benson Veg. Comm. ID 41 - River Red Gum open woodland of intermittent watercourses mainly of the arid climate zone
- Benson Veg. Comm. ID 359 - Porcupine Grass – Red Mallee – Gum Coolibah Hummock grassland / low sparse woodland on metamorphic ranges on the Barrier Range, Broken Hill Complex Bioregion
- Benson Veg. Comm. ID 153 - Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones
- Benson Veg.Comm. ID60 - Black Oak Woodland of the semi arid zone

Summaries of these vegetation communities are provided in the Stage 1a report (**ngh**environmental 2008a). Full diagnostic species lists and information for the seven vegetation types listed above are contained in Benson (2006) and Benson *et al.* (2006).

Some variations within the Mulga – Dead Finish community and the Prickly Wattle community were observed within the study area. The details of these variations along with a summary of the two undescribed communities are provided below. The approximate extent of all vegetation communities is shown on Map 4 and photographic examples are provided in Figure 1.

VARIANT ON ID 123 - MULGA – DEAD FINISH WITH GUM COOLIBAH AS A CO-DOMINANT ON UPPER ROCKY SLOPES

Gum Coolibah (*Eucalyptus intertexta*) was observed as the dominant or co-dominant canopy species within the Mulga - Dead Finish vegetation type at three locations within the survey area, specifically around Mount Franks and Mount Robe. This variation was observed on upper rocky slopes and crests predominately with south to southwest facing aspects. The species composition of the understorey was consistent with that described by Benson for Mulga – Dead Finish on stony hills.

Gum Coolibah is not listed as a characteristic tree within the vegetation community ID 123 '*Mulga – Dead Finish on stony hills mainly of the Channel Country and Broken Hill Complex Bioregions'* as described by Benson *et al.* (2006).

VARIANT ON ID 136 - PRICKLY WATTLE OPEN SHRUBLAND OF DRAINAGE LINES WITH SPINIFEX GRASS UNDERSTOREY

One narrow drainage line within the area of Lakes Grave Creek contained the Prickly Wattle open shrubland vegetation type with Spinifex Grass (*Triodia scariosa*) in the understorey. Spinifex Grass is not listed as a characteristic groundcover species within the vegetation community ID 136

'*Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone'* as described by Benson *et al.* (2006). The drainage line extends from a nearby rocky hillslope which contains the vegetation community ID 359 '*Porcupine Grass – Red Mallee – Gum Coolibah hummock grassland / low sparse woodland on metamorphic ranges on the Barrier Range, Broken Hill Complex Bioregion'* as described by Benson & Sass (2008). Thus it is likely that this area represents an ecotone between the two vegetation types and Spinifex Grass seed is transported by water along the drainage depression.

UNDESCRIBED COMMUNITY 1: MULGA / RED MALLEE SHRUBLAND ON ROCKY SLOPES OF THE BARRIER RANGE

This community is presently undescribed as per Benson *et al.* (2006) and has not been identified elsewhere in NSW. Therefore, the study area provides the only known occurrence of this vegetation community in NSW.

This tall open shrubland is dominated by Mulga (*Acacia aneura*) and Red Mallee (*Eucalyptus socialis*) with a dense shrubby understorey dominated by *Dodonaea lobulata* and *Senna form taxon 'artemisioides'*. In the study area, this community was recorded at two separate locations around the Mundi Mundi Range. Investigation using air photo interpretation found several other patches across the study area. At both sites surveyed during onground field works, it was found to occur on south facing, steep rocky slopes. This was also apparent in the air photo interpretation. At one survey location within this community, the vegetation was found to be of a very high diversity and relatively undisturbed by grazing.

UNDESCRIBED COMMUNITY 2: CHENOPOD - RED MALLEE WOODLAND / SHRUBLAND ON GRAVELLY LOWER SLOPES

This community is presently undescribed as per Benson *et al.* (2006) and has not been identified elsewhere in NSW. Therefore, the study area provides the only known occurrence of this vegetation community in NSW.

This community is dominated by Red Mallee (*Eucalyptus socialis*) with Umbrella Wattle (*Acacia oswaldii*), Sugarwood (*Myoporum platycarpum* subsp. *perbellum*) and Western Rosewood (*Alectryon oleifolius*) also present. White Mallee (*Eucalyptus dumosa*) was also recorded along a slight drainage depression through the community. The shrubs Woody Cassia (*Senna form taxon 'petiolaris'*) and Mueller's Daisy Bush (*Olearia muelleri*) and the herbs *Maireana trichoptera* and *M. sclerolaenoides* form a major component of this community.

This vegetation community was recorded at only one location within the study area to the west of Lakes Grave Creek and was found to occur on gravelly lower slopes and stony rises. No additional occurrences were identified from air photo interpretation.

Benson ID 359 - Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland / low sparse woodland

Undescribed comm. 1. - Mulga - Red Mallee Shrubland on rocky slopes

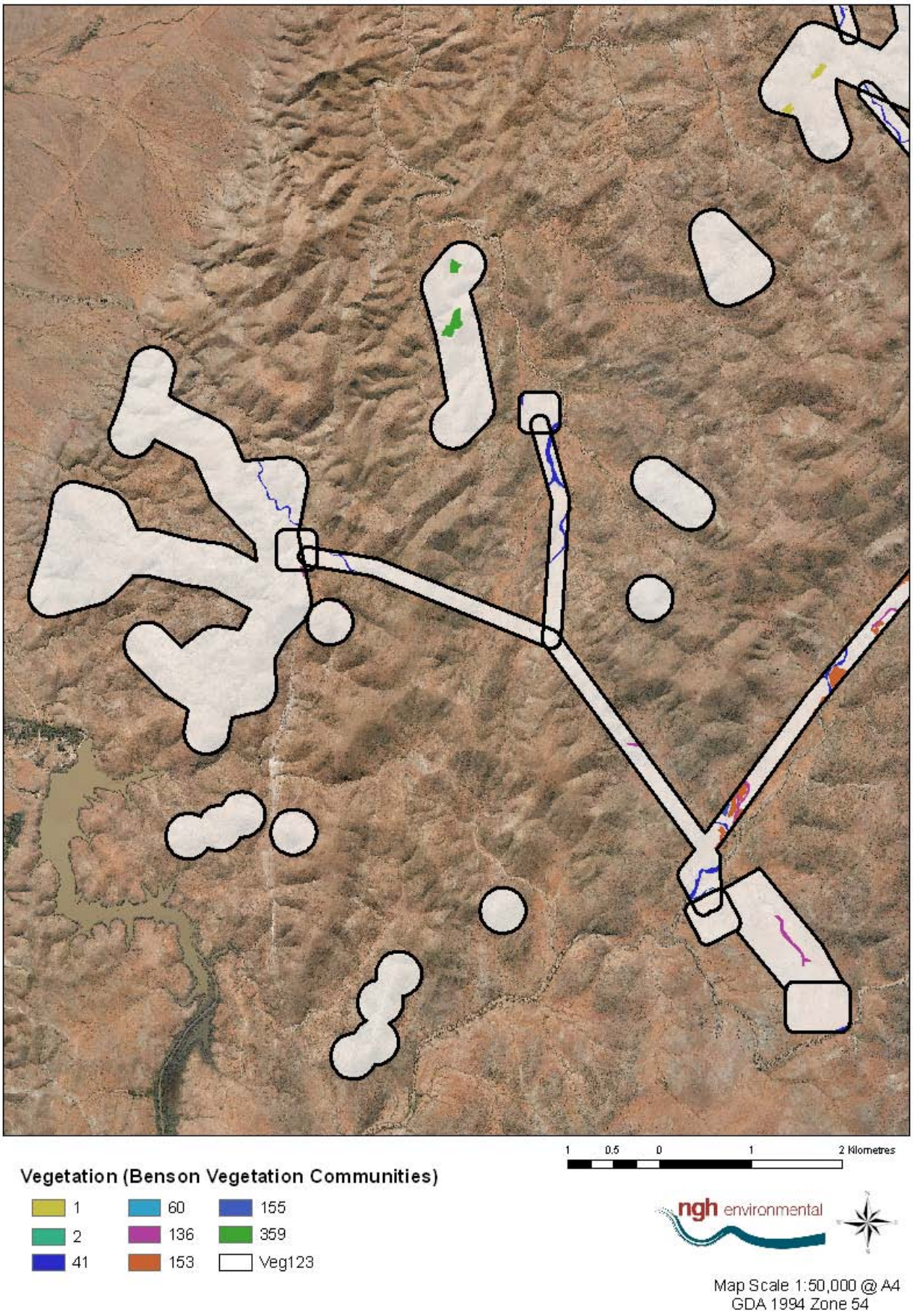
Undescribed comm. 2 - Chenopod – Red Mallee woodland/shrubland on gravelly lower slopes

Benson ID 123 - Mulga – Dead finish on stony hills and downs of the arid zone

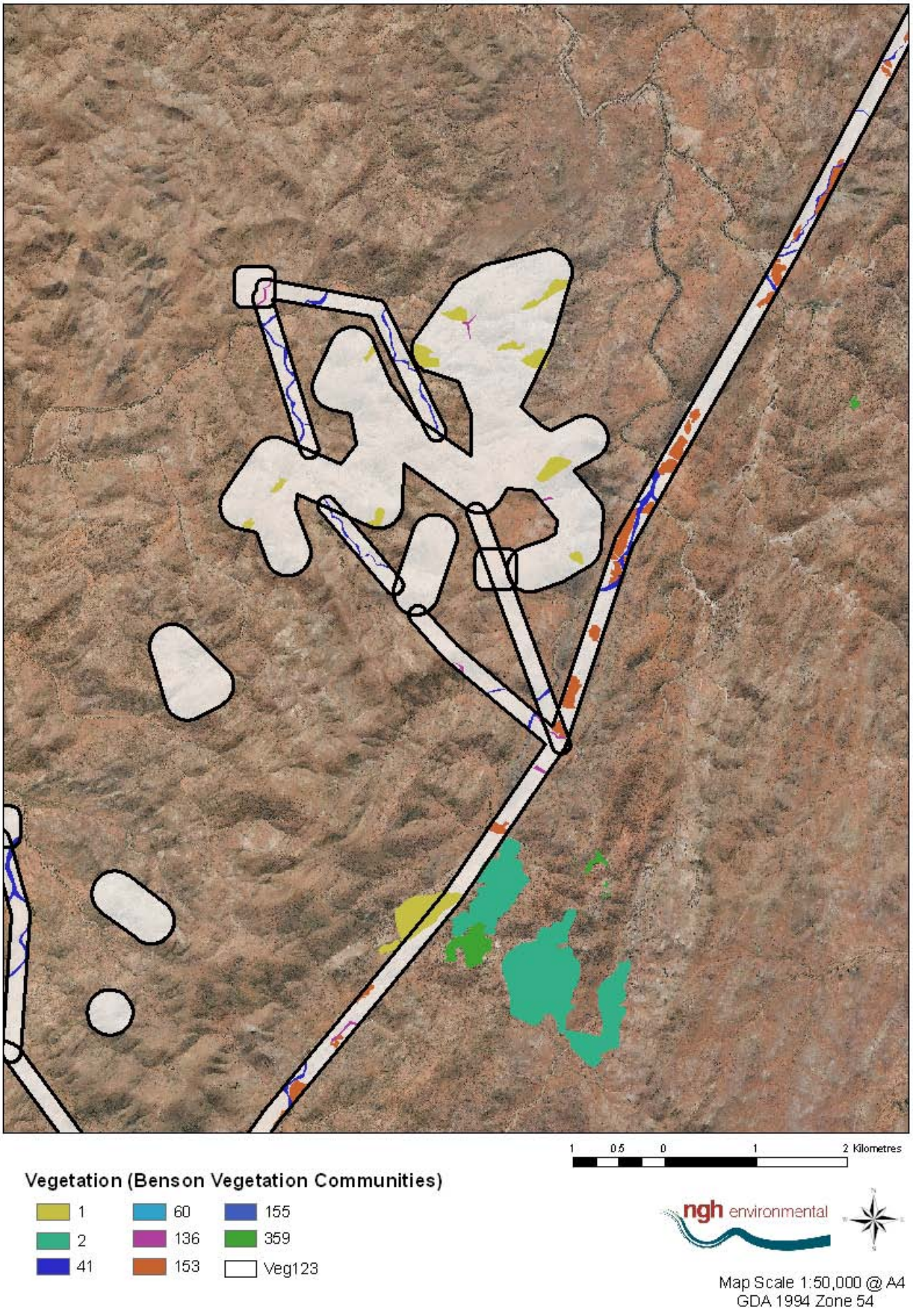
Benson ID 41 - River Red gum open woodland of intermittent watercourses

Benson ID 60 - Black Oak woodland

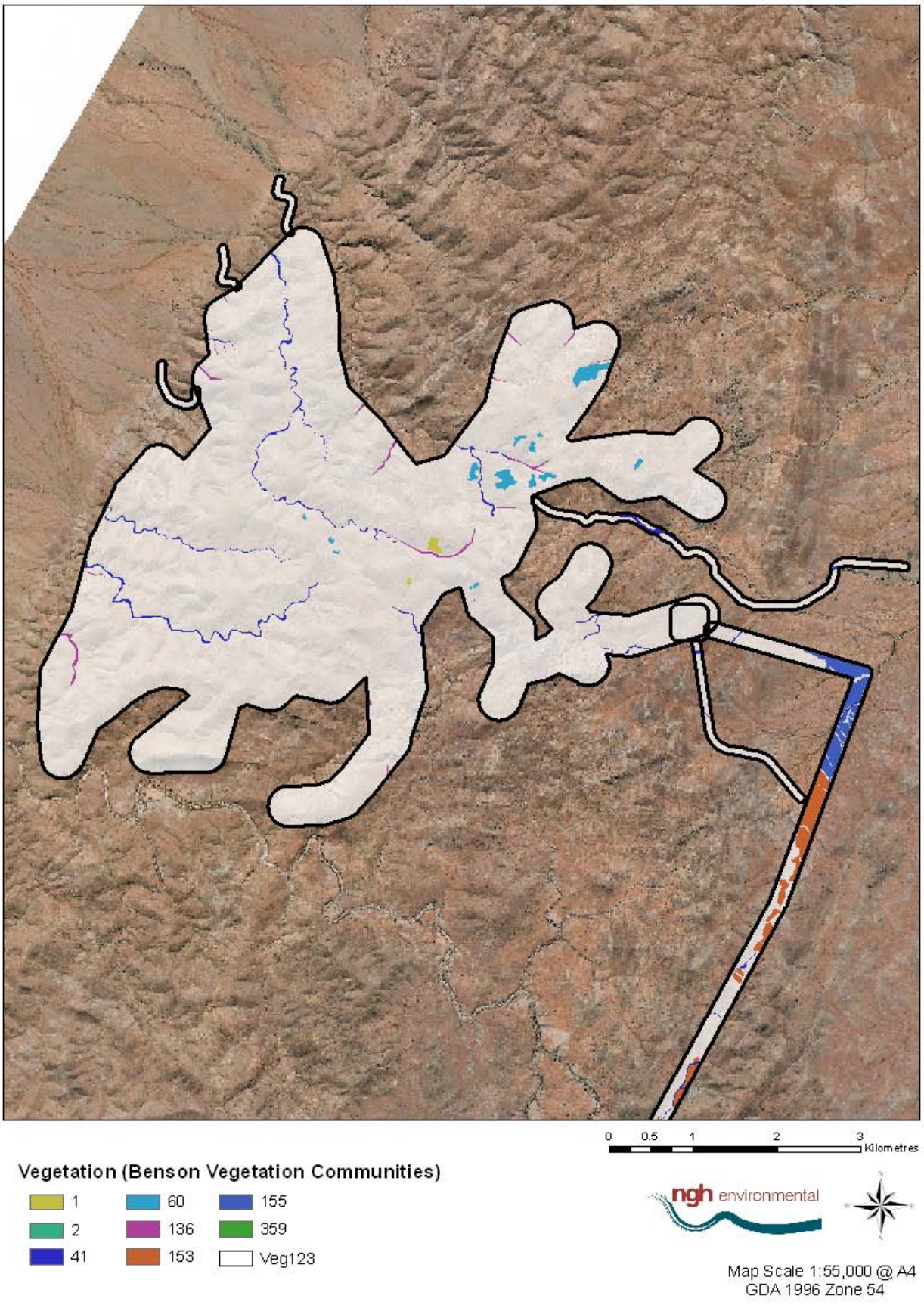
Figure 1: Examples of vegetation communities found across the study area.



Map 4.1: Extent of vegetation communities of the additional Stage 1b and 1c study areas



Map 4.2: Extent of vegetation communities of the additional Stage 1b and 1c study areas



Map 4.3: Extent of vegetation communities of the additional Stage 1b and 1c study areas

3.1.2 Conservation status of vegetation communities

The conservation status of each of the natural vegetation types present in the Stage 1b and 1c study area is summarised in Table 3 based on data presented in Benson et al. (2006) and **ngh**environmental mapping.

Table 3: Conservation status of natural vegetation types in the study area

Vegetation type	Pre-1750 extent (ha)	Current Extant (ha)	Reserves Total Area (ha)
Vegetation ID 123: Mulga-Dead Finish on stony hills	600,000 (+-30%)	500,000 (+-30%)	26,210
Vegetation ID 153: Black Bluebush low open shrubland	1,500.000 (+-30%)	900,000 (+-30%)	53,030
Vegetation ID 155: Bluebush shrubland on stony rises and downs	300,000 (+-30%)	150,000 (+-30%)	30,603
Vegetation ID 41: River Red Gum open woodland	40,000 (+-30%)	35,000 (+-30%)	6,920
Vegetation ID 234: River Red Gum woodland of rocky creeks	10,000 (+-50%)	9,000 (+-50%)	1,340
Vegetation ID 359: Porcupine Grass – Red Mallee – Gum Coolibah hummock grassland / low sparse woodland	350 (+-30%)	280 ha (+-30%)	None
Vegetation ID 136: Prickly Wattle open shrubland	5,000 (+-50%)	4,000 (+-50%)	None
Vegetation ID60 : Black Oak Woodland	50,000 (+-50%)	30,000 (+-50%)	3,600
Und.comm. 1: Mulga/Red Mallee shrubland on rocky slopes of the Barrier Range	Unknown	Currently, the community found in the study area is the only known occurrence within NSW (Approximately 60 ha)	None
Und. Comm.. 2: Chenopod - Red Mallee woodland / shrubland on gravelly lower slopes	Unknown	Currently, the community found in the study area is the only known occurrence within NSW (Approximately 150 ha)	None

While no Endangered Ecological Communities listed under Schedule 3 of the NSW *Threatened Species Conservation Act 1995* are present in the study area, the identification of two additional undescribed vegetation communities is regarded as significant. Both these communities represent unusual occurrences of Red Mallee as this species typically occurs on red aeolian sand (Harden 1991), and its presence on rocky ridges in the study area is significant. The details of these two new undescribed communities will be forwarded to Dr. John Benson of the Royal Botanic Gardens and consultation regarding the description of these communities should be undertaken between **ngh**environmental and SWFD.

It should also be noted that the previously undescribed community (Benson Veg. Comm. ID 359: Porcupine Grass – Red Mallee – Gum Coolibah hummock grassland / low sparse woodland) recorded during the 2007 survey has been nominated for EEC listing as this is the only known location of the community within NSW; a recommendation of the Stage 1a Biodiversity Assessment (**ngh**environmental 2008a).

3.1.3 Species recorded at the subject site

A total of 194 plant species were recorded during the flora survey, including 20 exotic species (refer to Appendix A). A large number of these species were not recorded in the 2007 surveys on Stage 1a. This was most likely influenced by the winter rains that occurred in 2008, and the level of

impact by grazing appeared less severe in the Stage 1c and the northern portion of Stage 1b. This list is not exhaustive due to the extensive nature of the study area, and the omission of some species which grow or flower outside the survey period, or after periods of heavy rainfall, may have occurred.

3.1.4 Species of conservation significance

Two species of regional significance, Curly Mallee (*Eucalyptus gillii*) and White Cypress Pine (*Callitris glaucophylla*) were recorded within the study area and are worth noting. Curly Mallee has not been recorded outside the Barrier Range bioregion (Benson 1999) and within this bioregion its occurrence is rare and restricted to sandy accumulations within mallee shrubland patches scattered amongst Mulga (PlantNET website). Approximately four mature individuals of this species were recorded at two locations in the study area within small, sandy drainage lines (Map 6). White Cypress Pine is a widespread species within NSW and is found mostly on sandy soils ranging from isolated individuals to extensive forests, particularly in inland areas (PlantNET website). The occurrence of this plant was a surprise, as the species is not associated with rocky ranges. The species has been extensively logged in the past across NSW and was only recorded at one location within the study area. One large mature individual and a smaller immature tree are present alongside an ephemeral creekline (Map 6).

No threatened plant species or Endangered Ecological Communities (EECs) were detected within areas that would be affected by the proposal. The development envelope is large and it is likely that not all species within it were recorded. However, flora surveys targeted representative vegetation types and habitat known to be favoured by threatened species and therefore it is considered unlikely that threatened species or EECs within the development envelope went undetected.

There are nine threatened plant species known to, or predicted to, occur in the Barrier Range CMA subregion; these include species listed under either the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (Bionet and DECC threatened species predictor tool based on the Barrier Range sub-region of the Broken Hill Complex Bioregion and Protected Matters search tool using a 30 kilometre buffer, respectively). These are:

- Purple-wood Wattle *Acacia carneorum*
- Silver Wattle *Acacia rivalis*
- Saltbush *Atriplex infrequens*
- *Dysphania platycarpa*
- Spike-rush *Eleocharis obicis*
- Showy Indigo *Indigofera longibractea*
- Yellow-keeled Swainsona *Swainsona flavicarinata*
- Slender Darling Pea *Swainsona murrayama*
- Creeping Darling Pea *Swainsona viridis*

An evaluation of species of conservation significance with potential to be affected by the proposal was undertaken using searches from the Bionet search tool (Broken Hill Bioregion) and the EPBC Matters of Environmental Significance search tool (using a buffer of 30kms from the site). Three species were evaluated as having potential to be affected:

- Showy Indigo *Indigofera longibractea*
- Yellow-keeled Swainsona *Swainsona flavicarinata*

- Creeping Darling Pea *Swainsona viridis*

Two endangered ecological communities are also known to, or are predicted to, occur in the subregion. These are:

- Neila woodland
- Aquatic ecological communities in the natural drainage system of the lowland catchment of the Darling River (DECC 2007)

Pursuant to the NSW *Threatened Species Conservation Act 1995*, a 7-part test was undertaken to properly characterise the significance of potential impacts on these species during the Biodiversity Assessment undertaken for Stage 1a (**ngh**environmental 2008a). This assessment concluded that the potential for significant impact on these species is low.

3.1.5 Disturbance and weeds

As with the original Stage 1a study area, the Stages 1b and 1c study areas have suffered significant disturbance since European occupation. The primary causes of this degradation include inappropriate grazing and alteration of the fire regime.

The condition of the Mulga-Dead Finish vegetation community throughout the study area is poor, and characteristic of past land use practices across the Western Division. In most areas, the key tree species are absent or very few, being dominated by dead stags. There is very little regeneration of key species such as Mulga and Dead Finish across most of the development area and many palatable species were suffering the effects of grazing by introduced herbivores.

Four exotic species were recorded at just under half of all the sites surveyed. These include:

- Wards Weed *Carrichtera annua*
- Winged Sea Lavender *Limonium lobatum*
- *Rostraria pumila*
- Arabian Grass *Schismus barbatus*

It is important to note these species were not recorded during the 2007 survey and their presence in the study area is most likely a result of the winter rains.

Despite the degradation and structural changes to these communities occurring as a result of past and current land use practices, the majority of the study area is generally dominated by native flora species, with only 20 introduced species recorded. One Class 4 noxious weed, African boxthorn (*Lycium ferocissimum*) was recorded within the study area as declared by the *Noxious Weeds Act 1993* for the Unincorporated area. African boxthorn is an aggressive invader of pastures, roadsides, reserves, remnant bushland and waterways. It forms an impenetrable, spiny thicket that inhibits the movement of stock and provides a haven for feral animals. The growth and spread of this species must be controlled according to the measures specified in a management plan published by the local control authority. Three individuals of this species were recorded within the study area at three separate survey locations (refer to Map 5).

3.2 Fauna and fauna habitat

3.2.1 Fauna survey results

SPECIES RECORDED DURING THE SURVEY

Eighty-nine species of fauna were recorded during field surveys. This includes 20 species not recorded in the 2007 surveys. With 123 fauna species recorded in 2007, this raises the total

number of fauna species recorded during the 2007/08 surveys in the wider study area to 143 fauna species (see Appendix B for details).

AVIFAUNA

Sixty species of avifauna were recorded during the recent survey. Bird diversity varied between the current survey and that of the 2007 surveys, which would be expected to vary considering the difference in seasonal timing of each, and the winter rains that the region has experienced. Additional species not recorded during the 2007 surveys included Southern Whiteface, White-backed Swallow and Crested Bellbird. Southern Whiteface and Crimson Chat were the most commonly encountered bird species during the survey period.

As in 2007, higher levels of bird diversity were apparent along drainage lines where a higher level of flora biomass in comparison to the surrounding areas was evident. Tree hollows along major drainage lines provide a roosting and nesting resource for hollow-dependant avifauna.

REPTILE FAUNA

Fifteen species of reptile were recorded during the recent survey. In contrast, species diversity was almost double in the 2007 surveys with 27 species recorded. The paucity of species recorded in the 2008 surveys is reflective of the lower temperatures during the survey period rather than differences in habitats or habitat quality. No reptiles were captured using conventional trapping techniques such as funnel trapping and elliots traps. All individuals were found during active and passive searches of habitat.

Of interest, numerous Tawny Rock Dragons (*Ctenophorus decressi*), not usually observable in cooler temperatures, were recorded basking. Many individuals appeared to have recently eaten a large quantity of food, correlating with a very high abundance of caterpillars observed during the survey period.

MAMMAL FAUNA

Fourteen species of mammal fauna were recorded during the recent survey, and a further seven species were identified from subfossilled remains, which brings the total number of mammal species recorded for the entire study area to 27 species. While the mammalian fauna abundance was dominated by introduced species, a number of species are significant.

Evidence of the past existence of Yellow-footed Rock Wallaby (*Petrogale xanthopus*) was found near Mt Robe by aged scats. The Barrier Ranges is within the historic range of *P. xanthopus* and from our observations it appears that there is limited potential habitat to be found within the development envelope. At one site, south-west of Mt Robe, a rocky complex of boulders, exposed faces and ledges revealed aged scats that may have been produced by a Petrogale. In addition, and more significantly, were observations of “shiny rock”; a feature of rock wallaby occupied habitat. After extensive searches, no fresh faecal material was located but deep within the crevices and under the cave floor debris old scats likely to be from Petrogale were identified. Discussions with the lesees of Purnamoota Station revealed the historical presence of Yellow-footed Rock Wallaby at Mt Robe. Furthermore, old records are also shown in the NSW Atlas of Wildlife Database for the area.

Historical and current super-abundant populations of introduced species (goats, rabbits and foxes - the main predator of rock wallabies), make it highly unlikely that the Yellow-footed Rock-wallaby could have persisted in this area. During recent droughts, rabbits and goats would have been significant competitors for decreasing food and water resources. Goats would have aggressively driven rock wallabies from the refuges amongst the rocks; this is evident from the piles of goat scats in every significant rock outcrop inspected. Foxes would have predated easily on small Rock-wallaby colonies, causing localized extinctions and fragmentation of the population, likely to have caused a significantly adverse impact on the local population.

Within this same rock outcrop complex, numerous subfossilised bones of mammals were found. These were sent to Graham Medlin, a Research Associate of the South Australian Museum specialising in subfossill remains. From this sample, numerous mammals were identified. There were the Short-tailed Hopping Mouse (*Notomys amplus*), Long-tailed Hopping Mouse (*Notomys*

longicaudatus), Goulds Mouse (*Pseudomys gouldii*) and Plains Rat (*Pseudomys australis*). All four species are listed as PRESUMED EXTINCT on the schedules of the NSW Threatened Species Conservation Act 1995. It is not uncommon to find material presenting evidence on extinct mammal fauna in western NSW; material from similar rocky landscapes in Mutawinji National Park and Yathong Nature Reserve (both in western NSW) present evidence of similar extinct mammalian fauna. Similar to the case for Rock-wallaby persistence, the current habitat appears insufficient to support these species today.

Three other mammals were also identified from these remains. These were the Stripe-faced Dunnart (*Sminthopsis macroura*), Long-haired Rat (*Rattus villosissimus*) and Kultar (*Antechinomys laniger*).

The remains of all of these mammals were located within a cave of a rocky outcrop near Mount Robes. The outcrop contained caves, crevices and rock jumbles. The bones were loosely buried amongst fine dirt, but still visible on the surface. The majority of the remains were found near the cave entrance, with sufficient natural light to enable collection without a torch. This might suggest that this cave was historically used by a raptor, presumably an owl. It cannot be stated with certainty the exact age of these samples, however, their location partially buried inside a natural cave and the subfossillised nature of the remains suggests that they are not recent.

The later three species identified from the subfossilled remains are listed as Vulnerable (*S.macroura* and *R.villosissimus*) and endangered (*A.laniger*) under the NSW Threatened Species Conservation Act 1995. Habitat across the study area has become significantly degraded by feral goats, and it is unlikely that conditions are conducive to supporting these species currently. Trapping across the study area, and searches for scats and remains over the past years, has not detected the current or past presence of these species in the study area. All three species are known to be threatened by the degradation of their habitat by feral goats. Control of the goat population across the study area is recommended with the proposed wind farm, and would be considered a net gain in habitat should these species persist in the study area.

Microbat fauna varied between the current and the 2007 surveys with two additional species identified that were not recorded in 2007. Bat fauna recorded during 2007 and 2008 total 9 species, including two threatened species; Little Pied Bat (*Chalinolobus pictus*) known from a single record in 2007 and Yellow-bellied Sheathtail Bat (*Saccolaimus flavicentris*) also a single record in 2008. While microbat diversity is considered typical of this semi-arid landscape, the absence of water points required for foraging and drinking, is likely the limiting factor explaining low levels of abundance. However, temperatures were cool to mild during the recent survey, which would impact on microbat movements. The weather conditions during the 2007 surveys to the south were more conducive to detecting microbats adequately.

Goats were the most abundant mammal onsite and the effect of their grazing and degradation of rock outcrops was evident across all habitat types.

FROG FAUNA

No frog species were recorded during the recent survey. Despite minor rainfall during the survey period, cooler temperatures were not conducive to frog detection. The drainage lines, and softer soils of the plains are likely to provide habitat for a number of common frog species. One species of frog was recorded in the 2007 surveys (Desert Tree Frog, *Litoria rubella*). This species has a widespread distribution across western NSW and is regarded as a common species.

3.2.2 Fauna habitats in the study area

Investigations of Stage 1b and 1c study area revealed a number of general habitat types, similar to those identified in the Stage 1a survey areas targeted in 2007. These can be summarised as rocky outcrops and ridges, shrublands, hummock grasslands, drainage lines/water points and plains. Other habitat features were found to include hollow-bearing and mature vegetation and mine shafts and caves. These habitats play an important role in sustaining native fauna populations on site and potentially, in the locality, and are discussed below. Figure 2 provides a graphical representation of these habitats.

ROCKY OUTCROPS AND RIDGES

Initial aerial photograph interpretation undertaken for the Biodiversity Constraints Technical Report (**ngh**environmental 2008b) identified large areas of rock outcropping which have the potential to provide habitat to rock-obligate fauna such as the threatened Tawny Rock Dragon. However, as detailed in the earlier Stage 1a biodiversity assessment, survey for this species must occur at an appropriate time to determine habitat use. As such, a specific study on the Tawny Rock Dragon and their habitat is recommended as discussed in detail in Section 3.2.4. This report does not address rock outcropping as potential habitat for the Tawny Rock Dragon further.

Generally, the rocky outcrops range in area from discrete to extensive; in some cases outcrops were less than one metre square, whilst in others entire ridgelines and adjacent slopes were covered by large partially buried boulders. In many areas, the rocky outcrops of the Stage 1c study area differed from those observed in the 2007 surveys to the south and those within the Stage 1b study area. Several outcrops in the Stage 1c study area possessed features such as natural caves, ledges and exposed faces. The size of the rocks also varied from small fragments typical of scree slopes to large consolidated rock shelves. Rocks and crevices provided a large variety of refuge for reptiles and mammals. Many of the larger outcrops appeared to be preferred sites for goat occupation. In these areas goat scat was abundant and vegetation was sparse.

The distinct delineation of ridges rising above the surrounding plains creates updrafts and roost sites preferred by raptors such as the Wedge-tail Eagle. Prey available to raptors onsite includes goat kids, rabbits, small mammals and reptiles.

SHRUBLANDS

Trees, which were mostly low growing, were sparse over most of the site. In more sheltered landscape positions (lower slopes and south facing slopes), more dense concentrations of Mulga trees provided roosting and nesting habitat for birds and bats (Babbler nests were abundant in these areas).

Large areas of tree die back were evident across the study area, similar to that in the 2007 survey area. Evidence of goat grazing and drought is apparent. These areas provide limited habitat to native fauna. Regeneration of key vegetation species such as Mulga was not observed across the study area.

HUMMOCK GRASSLANDS

Additional areas of Spinifex grassland were found during air photo interpretation and subsequent ground validation within the Stage 1b and 1c development envelope, targeted in 2008. These were located on the eastern site of the proposed transmission easement connecting the northern and southern sections of the proposed wind farm, and directly east of the larger patch identified in the 2007 survey. The landscape location of these was predominantly mid slope and ridgetop. However, in the east of the study area, Spinifex was present in drainage lines within the proposed easement. As discussed in the previous report, ridges are an unusual landscape position for Spinifex in NSW (**ngh**environmental 2008a). Additionally, Spinifex within drainage lines is also considered unusual, and appears to result from the seed dispersal through drainage lines from the mid slope/ridge position of Spinifex patches. Spinifex grass in the Barrier Ranges is regarded as a regionally important habitat resource and is considered significant habitat for Spinifex-obligate species; a number of which have been recorded during this and previous surveys.

PLAINS

The plains contain low ground cover, shrubs and trees, usually of very sparse density. Soils were fine and clay based but non-cracking, probably containing a substantial component of Aeolian sand. Fauna habitat was limited in these areas with rocks and fallen timber providing a limited refuge for ground-dwelling reptiles and mammals.

DRAINAGE LINES AND WATER POINTS

Umberumberka Dam provides the only large source of free standing water within close proximity of the site. It is an artificial structure constructed in 1915, covering 145 hectares and capable of storing almost nine mega litres. Artificial water points at Eldee and Purnamoota Station would also

provide drinking points for more mobile fauna such as birds, microbats and larger mammals. Larger ephemeral creeks in the study area include Mundi Mundi Creek, Eldee Creek, Big Aller Creek, Little Aller Creek, Lakes Grave Creek and Lakes Creek. All creeks are likely to provide free water and moist seeps for some time following larger rainfall events. They also contain large hollow-bearing trees, increasing the value of this fauna habitat as a refuge and source of water.

Some smaller, ephemeral drainage lines carrying Prickly Wattle (Benson Veg Comm ID 136) were also found to host Spinifex grass. In the two sites identified, these were directly downstream of Porcupine Grass – Red Mallee – Gum Coolibah Hummock grassland / low sparse woodland (Benson Veg Comm ID 359). The presence, and regional significance, of Spinifex is earlier noted.

HOLLOW-BEARING AND MATURE TREES

Large hollows are present in the mature River Red Gums growing within the major drainage lines within the study area. These include drainage lines west of the range adjacent to the Mundi Mundi plains, within the ranges, and east of the ranges in the vicinity of the proposed transmission easement. Large hollows (>10cm diameter) appear only to occur in association with ephemeral drainage lines in this landscape. Therefore, species requiring large hollows (including owls, arboreal mammals and colonial bats) will be dependant on these areas for refuge.

While some smaller hollows were present in Mallee vegetation on ridges and slopes, it is likely that the value of these to woodland birds and microbats may be diminished by their degree of exposure to strong winds particularly on westerly facing slopes.

Dense concentrations of Mulga and Mallee trees were most often present in association with south facing slopes, presumably due to the higher moisture retention in these more protected areas. Given the extensive amount of die back over the many parts of the study area, the refuge provided in these protected areas is likely to constitute an important habitat resource. Babbler nests were often abundant in these areas.

While larger trees suitable for raptor nests are sparse within the study area, usually found only in association with drainage lines, smaller trees were found in the 2007 surveys, to support raptor nests. In some instances, Wedge-tailed Eagles nests were found as low as 1.5m above ground level (**ngh**environmental 2008a).

MINE SHAFTS AND CAVES

As identified in the 2007 surveys, the study area has a history of mining use and several shafts were observed across the ranges. Natural caves and overhangs were also revealed, and were more common in the northern parts of the study area. These sites can provide refuge for microbats. The site is subject to extremes of temperature, increasing the importance of thermoregulation for bats and reptiles, which is likely to place higher importance on these habitat features. The lack of free standing water however, reduces the likelihood that bats regularly use these areas.

EFFECTS OF GRAZING ON FAUNA HABITAT BY FERAL GOATS

As in the 2007 surveys, goat grazing was found to be the likely key factor currently determining the level and quality of habitat on the site for many native fauna species. They were found to be utilizing the plains, slopes and ridges (evidenced by scat and browsed vegetation). While their abundance in the 2007 surveys appeared to be greater in the southern and western sections of the study area, winter rain and an abundance of food at ground level is likely to have resulted in their dispersal across the study area, rather than a congregation closer to Umberumberka Dam. Most of the lease holders undertake some form of goat harvesting. However, an absence of any regeneration by key flora species such as Mulga, suggests that goats continue to play a large role in the degradation of the study area's habitat.

nghenvironmental (2008a) discussed the ecology of feral goats and identified that Umberumberka Dam is likely to be a key resource to goats in the local area as would any other water point, natural or artificial. During this survey, a natural water point located on the southern side of Mount Franks revealed signs of frequent goat use including 'kid dropping' in nearby rock outcrops (use of the

rock outcrops as goat nurseries). Other natural water points were likely to be scattered across the study area.

Figure 2: Examples of fauna habitat types present in the study area.

Rocky outcrops and ridges

Rocky outcrops and ridges provide breeding and refuge habitat for a number of fauna species including many reptiles.

Shrublands

Mulga and Mallee woodland provide varying degrees of habitat, but most are heavily degraded by goat grazing.

Plains

Fairy wrens and reptiles were recorded in the sparsely vegetated plains either side of the range.

Drainage lines and water points

Drainage lines dissecting the valleys and plains. These features were the only areas where mature trees bearing large hollows were present.

Hummock Grasslands

Spinifex provides a regionally significant resource for a number of fauna species.

Mine shafts and caves

Mine shafts and natural caves are likely to provide habitat for microbat, mammal and reptile fauna.

3.2.3 Profile of potential bird usage

The use of the site by birds is of particular relevance to wind farm development, as avoidance behaviour and direct collision impacts have potential to affect local populations.

GENERAL DESCRIPTION OF AVIFAUNA

The recorded diversity and abundance of birds within the development envelope was generally low with similarities to the 2007 surveys. Flocking species included Galahs, Australian Ravens and Wedge-tail Eagles which were also commonly seen flying over the range at heights that would place them at risk of collision with operational wind turbines. Babblers were present in more dense clusters of Mulgas, predominantly in the more protected lower slopes. Drainage lines harboured the greatest diversity of birds recorded in the study area, including Tawny Frogmouths, Red-backed Kingfishers, several species of honeyeater as well as White-winged Fairy Wrens. Some wetland species were recorded in the recent survey, likely to have been a result of sporadic winter rains. These included Australian Shelduck and Whiskered Tern. Two Australian Shelduck were observed on the adjacent Mundi Mundi Plain, while Umberumberka Dam revealed a single Whiskered Tern and numerous common wetland species.

RAMSAR WETLANDS AND MIGRATORY WETLAND SPECIES

There are no Ramsar wetlands close to the study area. Directly adjacent to the southern boundary of the proposed development, Umberumberka dam is an expansive water body covering 145 hectares. It is an artificial dam and is therefore unlikely to be an important regional resource for water birds. Nonetheless, the dam may attract migratory wetland species as it is the only source of permanent free standing water in the locality which has been present for more than 85 years.

Distinctive ephemeral drainage lines were found to contain high proportion of the avian diversity on site. This is likely to be because of the mature and hollow-bearing trees in these areas creating a rare refuge rather than because of the water resource that is only ephemerally present. These drainage lines are likely to be preferred movement corridors for many birds onsite, due to the cover they provide.

RARE OR LIMITING HABITAT FEATURES

Rare and limiting habitat features in the locality include mature hollow-bearing trees required for roosting and nesting as well as the distinct ridges rising above the surrounding plains which create updrafts and roost sites preferred by raptors. While mature and hollow-bearing trees occur predominantly within the drainage lines on the plains that would be only minimally affected by the proposal, the use of the ridges is likely to be influenced by the placement of turbines. Wedge-tail Eagle nests were observed near Mount Robe and during the 2007 surveys near Lakes Knob in the south of the Stage 1a area north of Umberumberka Dam (refer **ngh**environmental 2008a for details). Hummock grasslands are considered regionally significant habitat for a number of Spinifex-obligate reptile species. Whilst no such avifauna species have been detected to date in the study area, this habitat would be considered significant for these species if present.

The rabbit and goat population, coupled with the ridge slope updraft may provide an important feed resources for the Wedge-tailed Eagle and potentially other raptors. Nest sites, as discussed, are limited on the site.

GEOGRAPHICAL FEATURES THAT CONCENTRATE BIRD MOVEMENTS

As with the initial proposed Stage 1a area, the proposed Stage 1b and 1c areas are located on a series of ridges surrounded by expansive plains. The ranges, which provide a greater degree of refuge (including trees, shrubs, gorges and the general topographic shielding of winds in lower slope positions) may concentrate hunting, foraging, roosting and nesting behaviour for some species, particularly raptors. The likelihood of avoidance and collision impacts is therefore increased in the ranges, in comparison to the surrounding plains.

MIGRATION CORRIDORS

As discussed in the Biodiversity Assessment, daily and seasonal migration and movement corridors in the study area are not known (**ngh**environmental 2008a). The study area is not located between significant known habitat areas for migratory species, and as a result bird movements across the site may be diffuse and irregular (following rain), rather than concentrated and seasonal. No congregations of waterbirds were recorded at the subject site during the survey, and, given the habitat scale and quality, none would be expected to occur there. Umberumberka Dam may occasionally attract migrating species and a small number of common waterfowl species were present. This may lead to movements to the south of the study area on occasion.

3.2.4 Threatened and significant species

THREATENED SPECIES RECORDED ONSITE

Ten threatened species were recorded in the 2008 surveys (Map set 5). These being:

Birds

Redthroat (Vulnerable, TSC Act)

Pied Honeyeater (Vulnerable, TSC Act)

The presence of these species in the study area is not surprising considering the surrounding chenopod shrublands for Redthroat and the presence of Mistletoe and flowering Acacias as a food resource for the Pied Honeyeater. The Pied Honeyeater is encountered regularly across the study area.

Mammals

Yellow-footed Rock Wallaby (possible aged scat) (Endangered, TSC Act / Vulnerable EPBC Act)

Yellow-bellied Sheathtail Bat (possible anabat file) (Vulnerable, TSC Act)

Striped-faced Dunnart (subfossilled remain) (Vulnerable, TSC Act)

Kultar (Subfossilled remain) (Endangered TSC Act)

Long-haired Rat (subfossilled remain) (Vulnerable, TSC Act)

The presence of these species has been discussed in Section 3.2.1. Additionally, the Yellow-bellied Sheathtail Bat is known to occur in low abundance with roosts of one animal, or in groups of up to six animals known to occur in tree hollows and buildings or in rabbit burrows in treeless areas.

Reptiles

Marble-headed Snake-lizard (*Delma australis*) (Vulnerable, TSC Act)

Tawny Rock Dragon (*Ctenophorus decressi*) (Endangered, TSC Act)

Southern Spinifex Slender Bluetongue (*Cyclodomorphus melanops*) (Endangered, TSC Act)

One regionally significant reptile species was also identified. This being the Spinifex Snake-lizard (*Delma butleri*).

The threatened reptiles identified in the study area are interesting from a biodiversity point of view, as discussed in **ngh**environmental 2008a.

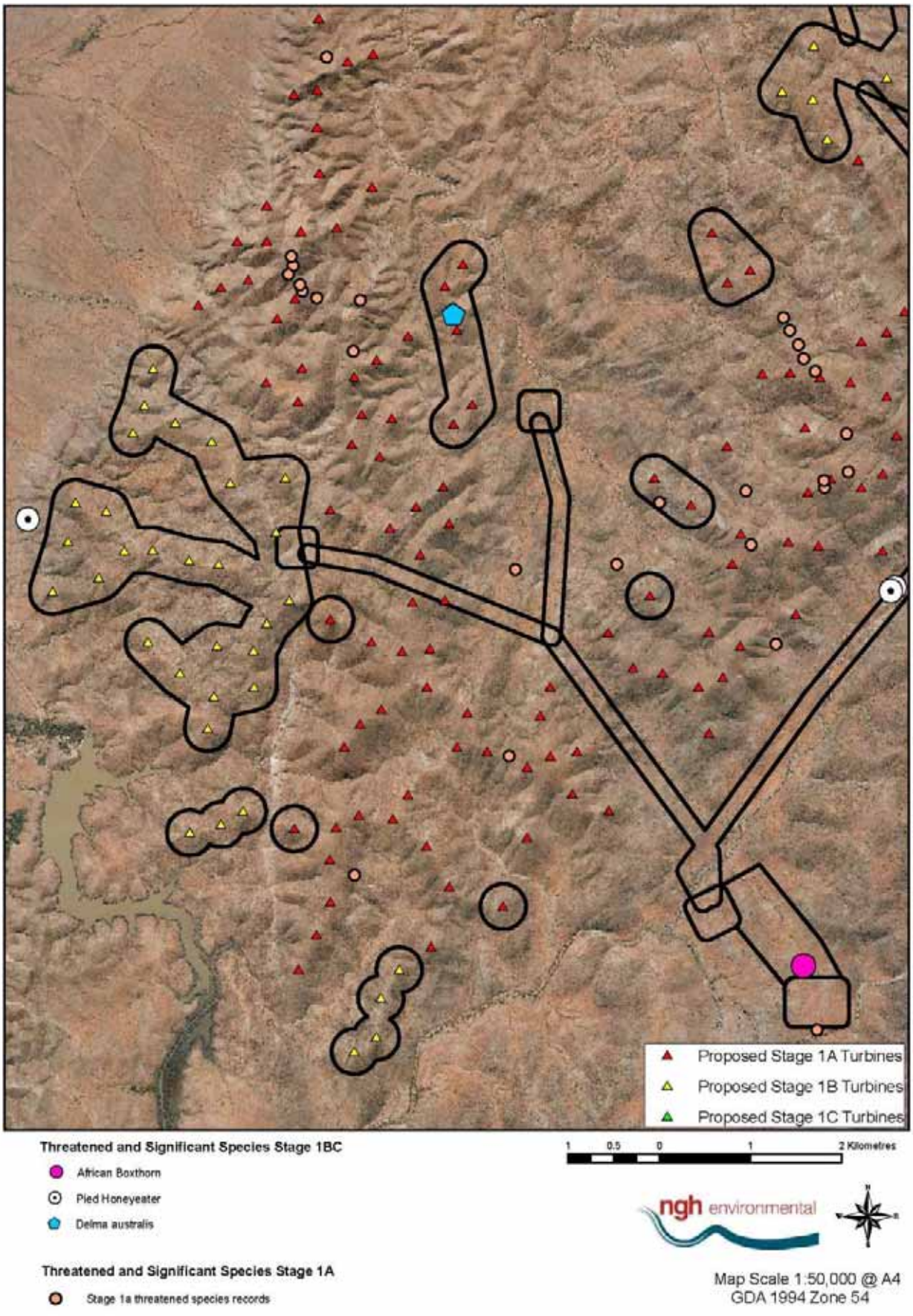
The populations of the two spinifex-obligate species (Marble-headed Snake-lizard and Southern Spinifex Slender Bluetongue) in the study area are highly significant from a regional and western NSW perspective and add a value contribution to the relatively few records of each species across NSW. Neither species has been recorded in the region prior to this study. Records for both species occur some 140 kilometres south where mallee occurs on sand dunes and plains. Spinifex habitat has been extensively cleared or highly degraded in NSW (Sass *et al*. 2005). The highly fragmented and in many cases, poor condition of many areas of Spinifex in NSW and the apparent absence of Spinifex on rock outcrops in NSW (apart from a very small area in Mutawinjii NP) reinforces the importance of this habitat type in the study area.

Specific to the Tawny Rock Dragon, the 2008 field survey was not conducted during weather conditions or seasonality conducive to accurately detecting the presence of this species across the Stage 1b and 1c areas. While some individuals were detected during the survey, this was likely the result of extremely high caterpillar abundance creating an opportunistic food resource. It does not provide an accurate indication of the extent of this species across the study area. It is recommended that surveys for Tawny Rock Dragon be undertaken during November/December when detectability is at its greatest. This is due to males being easily observed as they are actively displaying and defending their small territories which they do by perching on rocks. This method ensures that false absences are unlikely when surveying this species. This will allow for a more accurate determination on their distribution across the proposed development area.

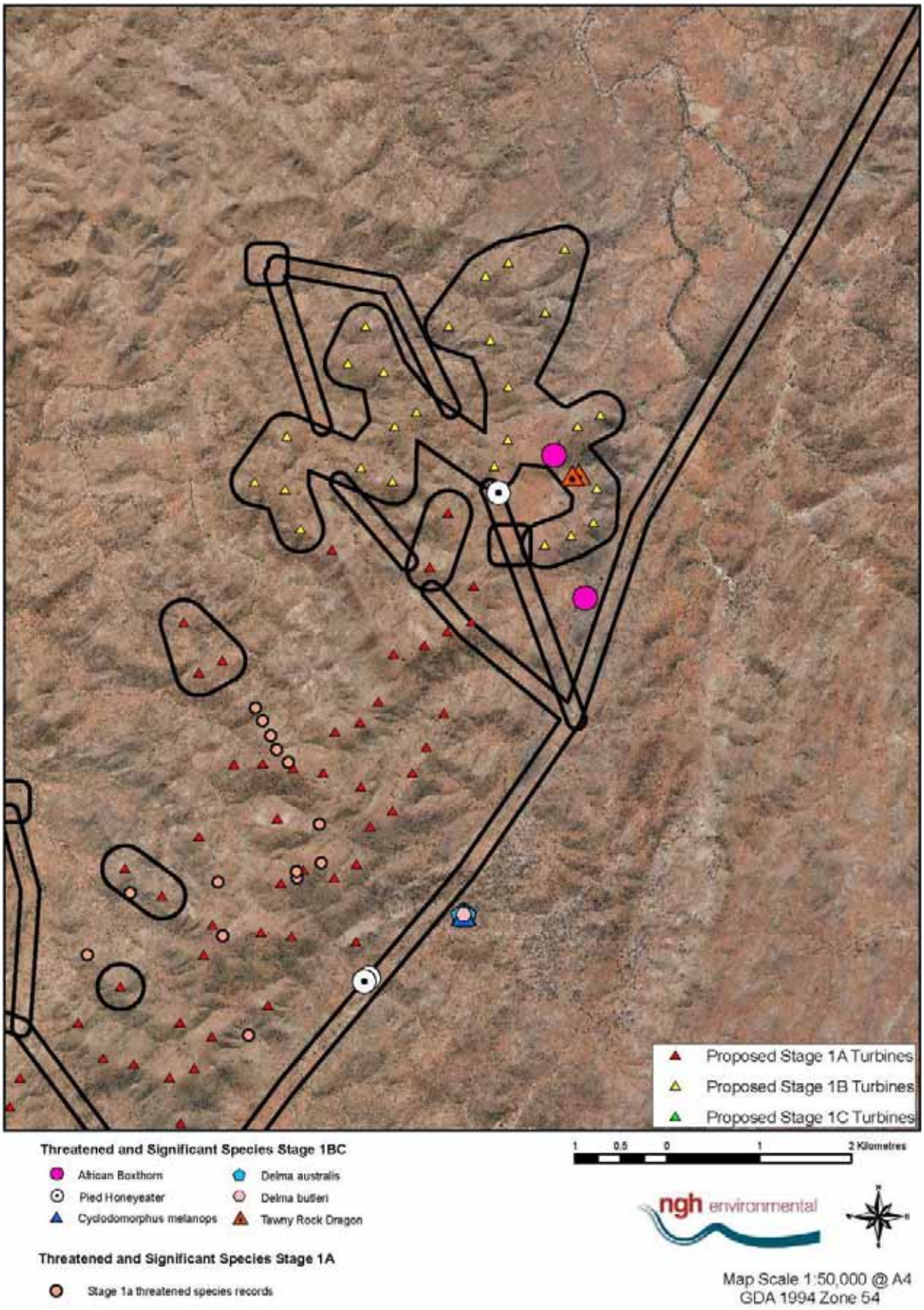
The species was initially listed as an E1 (endangered species) under the TSC Act following the determination of the scientific committee in 2002. Key factors to this determination included its restricted distribution (known from only three locations, with two of these known from only one animal) and the likely degradation of these habitat by introduced herbivores. The study area adds an additional known location for the species, and it is now considered the stronghold NSW (Peter Ewin, DECC, pers.comm.). However, it is likely that the distribution and long-term viability of this species onsite is threatened by the presence of feral goats, as many crevices were filled, or partially filled with goat scats; this is activity degrades potential habitat. Feral goats have already been attributed to the degradation of rocky habitats for other rock-crevice specialists such as the Broad-headed snake (*Hoplocephalus bungaroides*) (Murphy 1996) and the Centralian Ranges Rock-skink (*Egernia margaretae*) NSW NPWS 2000).

It is recommended that a study on the population status and distribution of the Tawny Rock Dragon be undertaken for the Stage 1b and 1c areas by conducting a properly timed survey. This study should have the following aims and objectives:

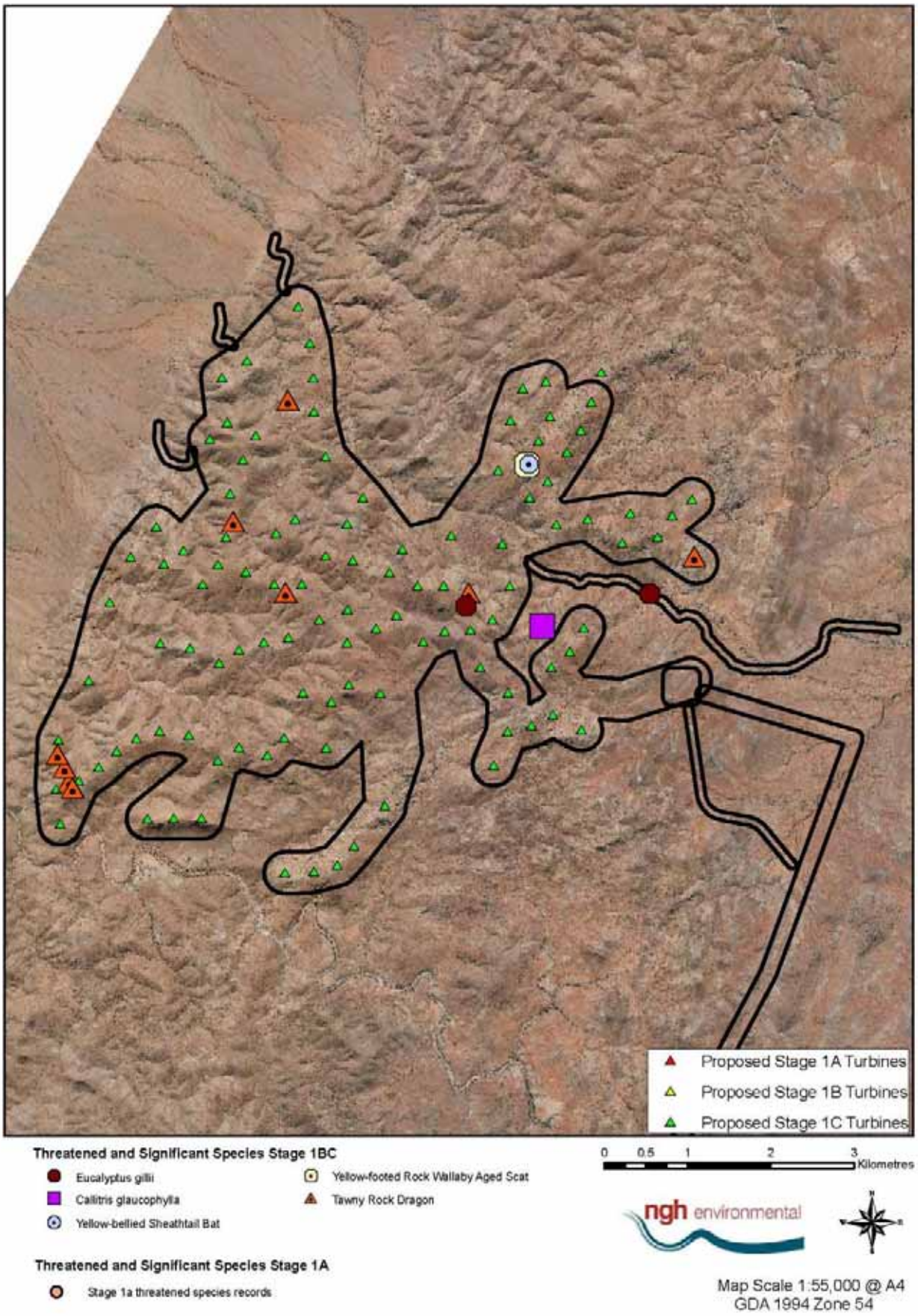
- Determine status and distribution of the Tawny Rock Dragon in the Stage 1b and 1c area
- Evaluate the rocky outcrops identified in the biodiversity technical report (nghenvironmental 2008b) for their potential to provide habitat for Tawny Rock Dragon in Stage 1b and 1c areas
- Determine any locations of Tawny Rock Dragon outside of the development envelope
- Identify any ‘hot spots’ for Tawny Rock Dragon that occur (ie, areas of high abundance)
- Undertake an analysis of microhabitats based on presence/absence of Tawny Rock Dragon in an effort to gain a greater understanding of their habitat requirements
- Determine if Tawny Rock Dragon occurrence is inversely correlated to the occurrence of another rock-obligate species, the Gidgee Skink,*Egernia stokesii*
- Provide discussion on the population of the Tawny Rock Dragon in the study area, the original Stage 1 study area, and the locality
- Provide discussion as to likely outcomes of a goat management plan
- Provide a clear set of recommendations for the management of this species in the Stage 1b & c area
- Provide an assessment of significance on the Tawny Rock Dragon (*Ctenophorus decressi*) based on the findings and recommendations of this study.



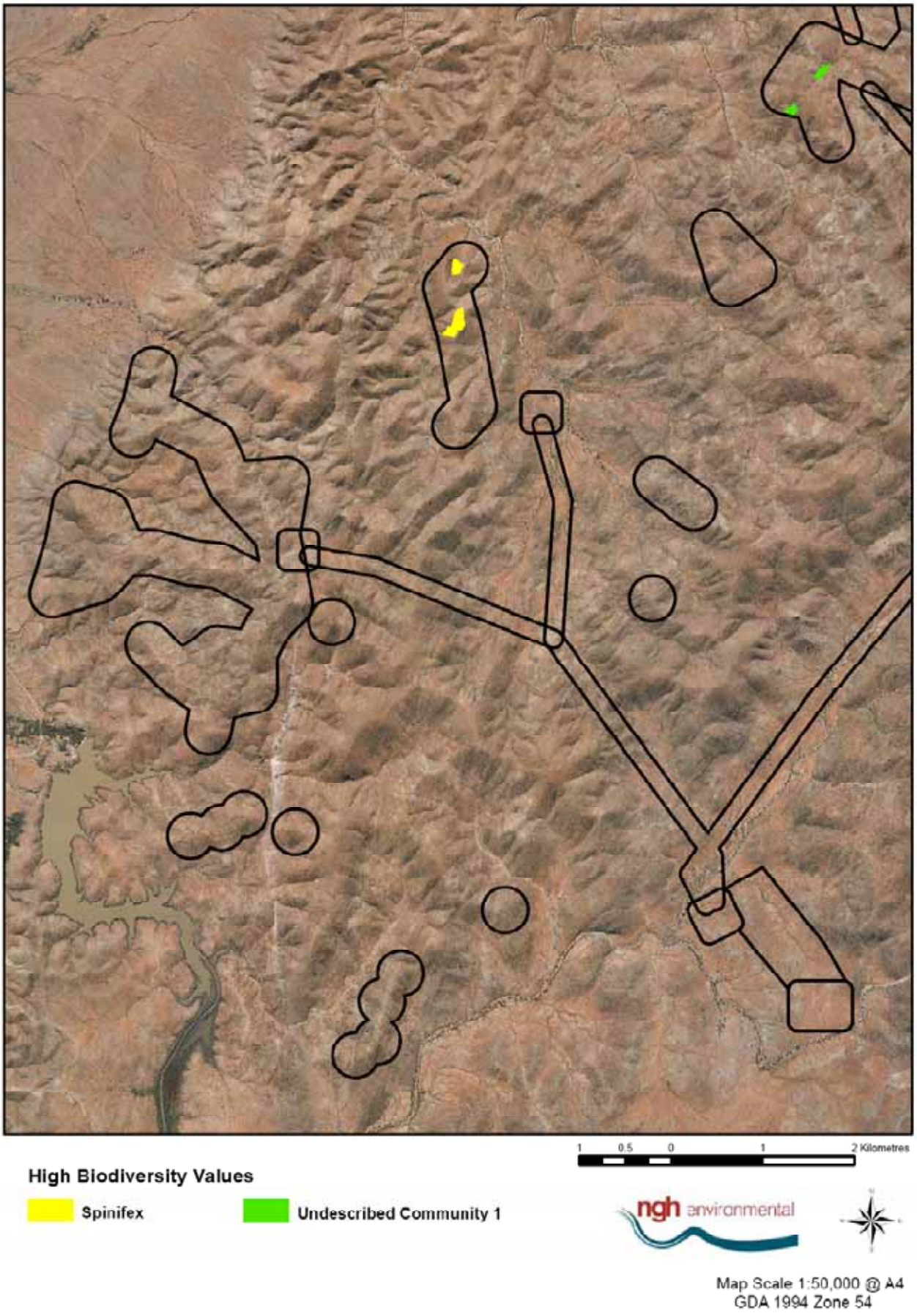
Map 5.1: Threatened and significant biodiversity of the study area



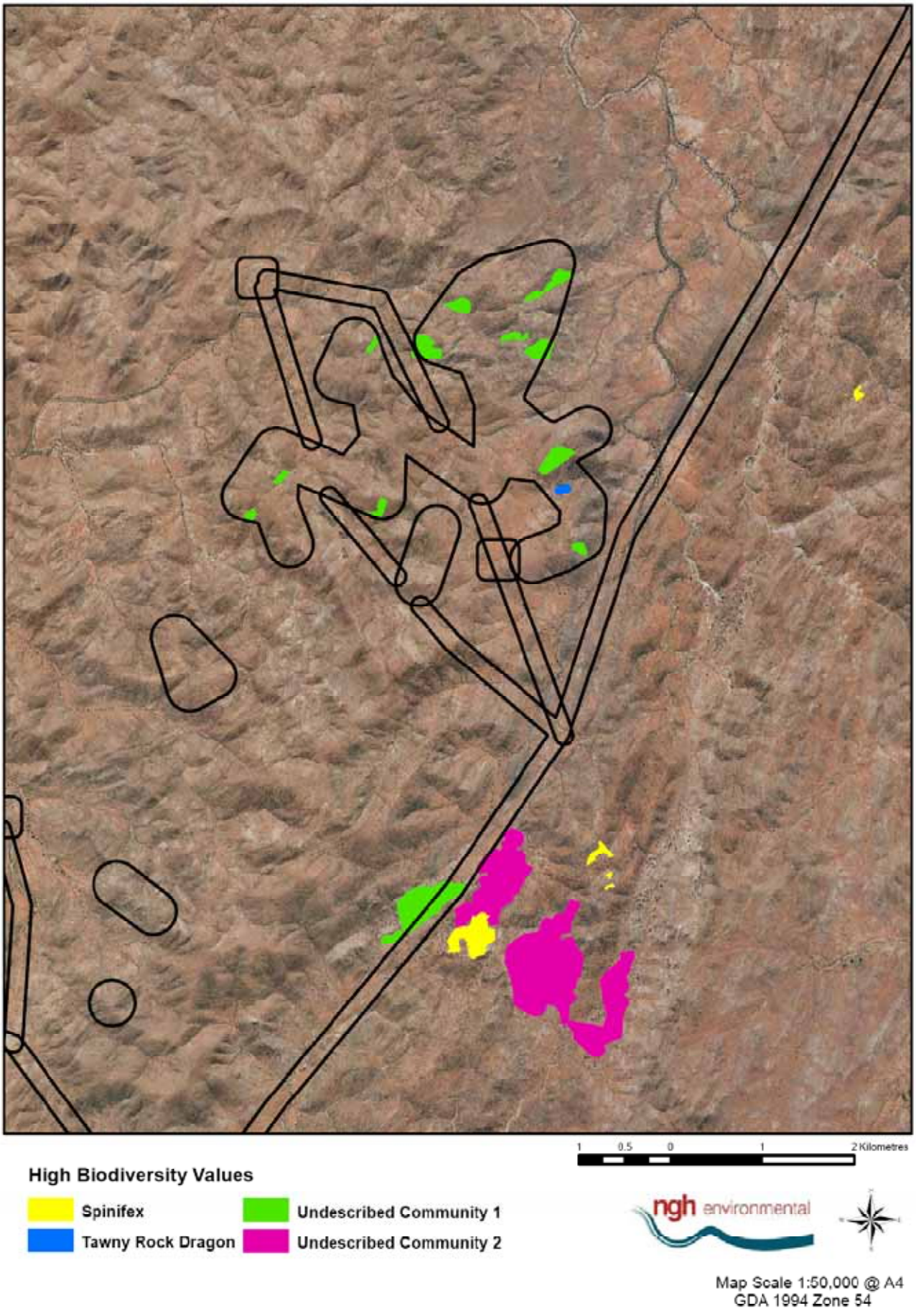
Map 5.2: Threatened and significant biodiversity of the study area



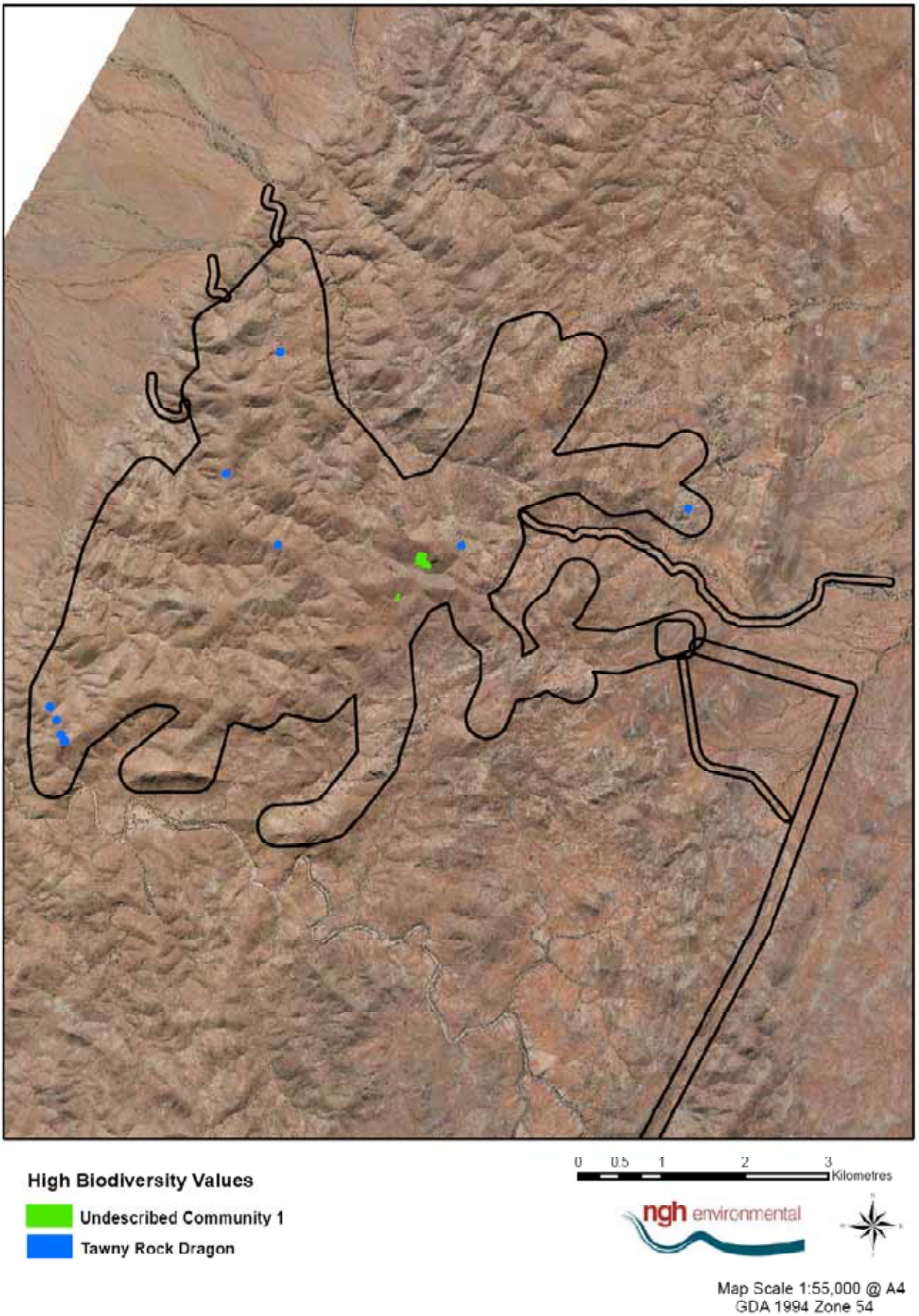
Map 5.3: Threatened and significant biodiversity of the study area



Map 6.1: High Biodiversity Value areas in the Stage 1b and 1c study area



Map 6.2: High Biodiversity Value areas in the Stage 1b and 1c study area



Map 6.3: High Biodiversity Value areas in the Stage 1b and 1c study area

4 IMPACT ASSESSMENT

4.1 Flora and vegetation communities

The proposed development would have substantial environmental benefits in terms of reducing green house gas emissions and the impacts of climate change, but it may also result in a number of adverse impacts to local biodiversity which would need to be avoided or mitigated. These can be considered in terms of the three phases of the development: construction, operation and decommissioning.

4.1.1 Construction impacts

Direct impacts
The proposal would result in the removal of vegetation within the development footprint, including turbine towers and the surrounding hardstand areas, control building, substation, new and widened access tracks and powerline poles associated with the internal power lines and the powerline linking the Mt Robe section to the southern areas of the proposed wind farm. Underground cable corridors would generally follow access tracks constructed between the wind turbines and other facilities.

Table 4 provides an estimate of the type and quantum of native vegetation loss required for the development of Stage 1b and 1c of the wind farm not assessed in the initial biodiversity assessment (illustrated on Map 7). Based on these calculations, these works would displace approximately 132 hectares of native vegetation. Approximately 11 hectares of native vegetation would be disturbed to enable the construction of the turbines; this could be rehabilitated after the construction phase. An additional 97 hectares could be rehabilitated after the life of the project. Approximately 24 hectares of native vegetation would be permanently displaced (footings would remain insitu after the project is decommissioned).

Areas of high biodiversity value were identified during the aerial photograph interpretation and onground surveys with specific regard to the identification of two undescribed vegetation communities (Mulga/Red Mallee shrubland on rocky slopes of the Barrier Range, and Chenopod - Red Mallee woodland / shrubland on gravelly lower slopes) and the 'Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland / low sparse woodland on metamorphic ranges on the Barrier Range, Broken Hill Complex Bioregion' (Benson & Sass 2008) previously recorded in the 2007 surveys. These are shown on Map-set 6. An existing access road flanks these two additional communities along the proposed transmission line easement which will require some level of widening to permit access. Beyond these specific works, these areas of vegetation should be protected from other impacts and should not be used for infrastructure or materials/equipment laydown.

Risks regarding habitat loss, modification and fragmentation remain, but have been substantially reduced. The following measures have been formulated to ensure the resulting risk to this community and the habitat it provides is addressed, and there is a net gain in relation to the condition and long term viability of this community onsite, including:

- During construction, clear demarcation of the two undescribed vegetation communities and the Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland to contractors to ensure that access beyond existing tracks in these areas is avoided where possible. An existing access road flanks the two undescribed communities along the proposed transmission line easement which will require some level of widening to permit access. Beyond these specific works, these areas of vegetation should be protected from other impacts and should not be used for infrastructure or materials/equipment laydown. This is particularly relevant along the transmission line between Mount Robe and the southern section where all three communities are present or adjacent to the proposed easement and existing access.
- Post construction, access tracks through, or adjacent to these communities, would where possible be modified to reduce their width to the previous track width. Ideally, this would include using rocks or artificial habitat such as roof tiles or pavers to reduce the track width as a

measure to reduce fragmentation and concurrently provide refuge to dispersing fauna and aid in the protection of germinating grasses.

- Post construction, a program to minimise goat impacts on the two undescribed vegetation communities and the Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland onsite would be implemented. These vegetation communities are presently degrading under current grazing management. The goal of this measure is to achieve a net gain within these three vegetation communities onsite.

Table 4: Estimated extent of vegetation loss

Where possible, the area of impact for proposed infrastructure has been estimated. Turbines and tracks are overlaid on vegetation types, Map 7 overleaf. For tracks and building / turbine footings, this would constitute a loss of habitat. For transmission lines, a small area would be removed to install poles. The greater proportion of the transmission line may require lopping where vegetation height exceeds 4m and minimal impact where vegetation is below 4m in height. There is some scope to microsite infrastructure based on flora values at the time of development.

	Qty. or length	Dimensions	Hectares	Impact Area within each vegetation community (hectares)								
				ID123	ID136	ID155	ID41	ID359	ID153	ID60	VEG1	VEG2
Tranmission/Switchyard and Maintenance compound[3]	2	300m x 300m	18	0	0	0	18	0	0	0	0	0
Site substations[3]	1	150m x 150m	2.25	2.25	0	0	0	0	0	0	0	0
Concrete Batch Plants[1]	4	150m 150m	9	6.75	2.25	0	0	0	0	0	0	0
Control and comms building[3]	1	20m x 30m	0.06	0.06	0	0	0	0	0	0	0	0
Construction compound[1]	1	200m x 100m	2	2	0	0	0	0	0	0	0	0
Turbine towers and footings[3]	169	15m x 15m	3.8025	3.78	0	0	0	0	0	0.023	0.0225	0
Access tracks onsite[2]	122km	6 m wide	73.026	70.8	0.09	0	0.24	0	1.14	0	0.66	0.096
Underground powerline cabling onsite[2]	122km	2m	24.342	23.6	0.03	0	0.08	0	0.38	0	0.22	0.032
Total hectares			132.4805	109.2	2.37	0	18.32	0	1.52	0.023	0.9025	0.128

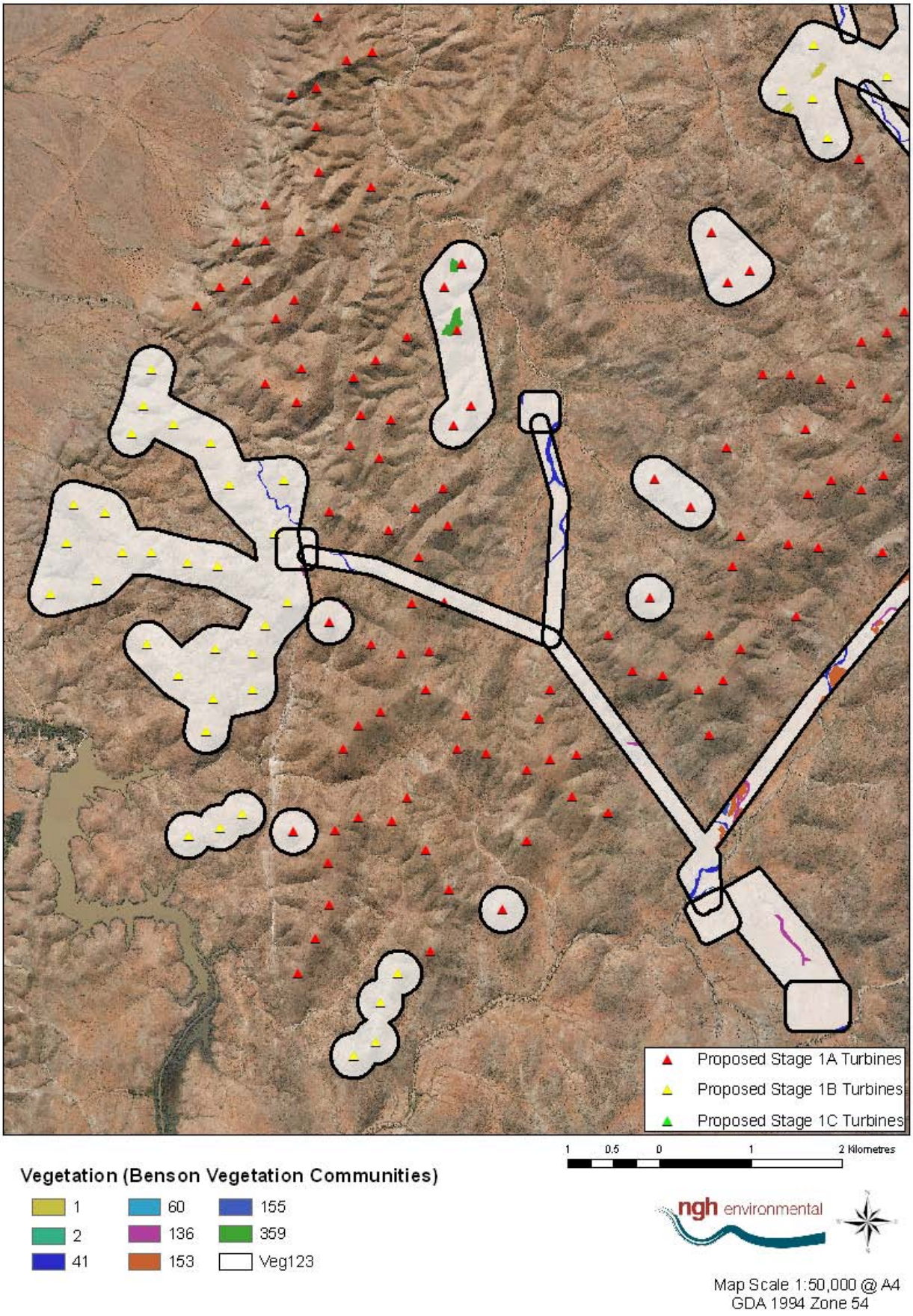
[1] Areas which could be rehabilitated after the construction phase = 11 ha

[2] Areas which could be rehabilitated after the life of the project = 97.368 ha

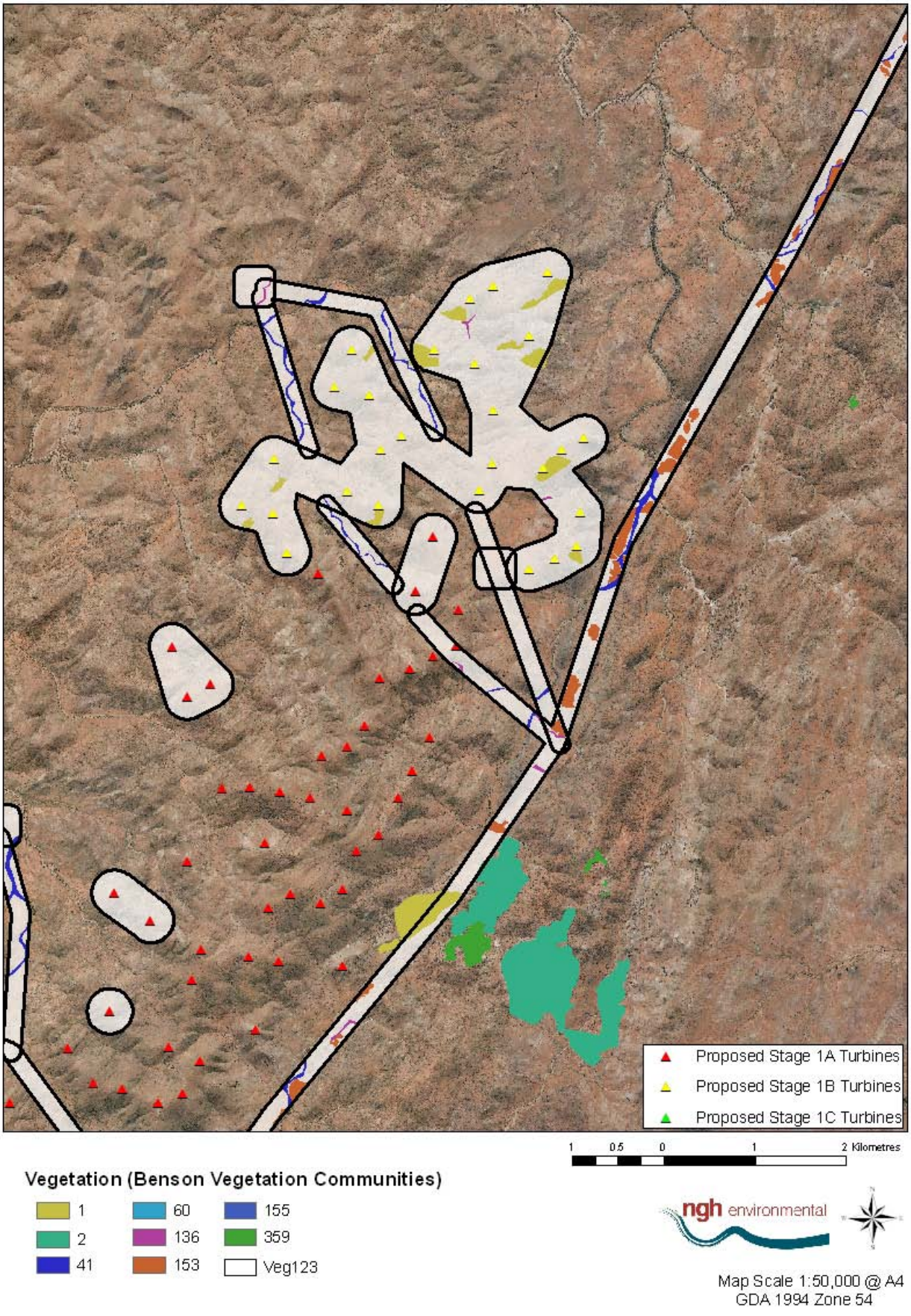
[3] Areas permanently impacted (includes all footings) = 24.112 ha

[4] Located within access tracks onsite where possible; these areas represent an estimated worst case scenario which is that no tracks could be located within access roads

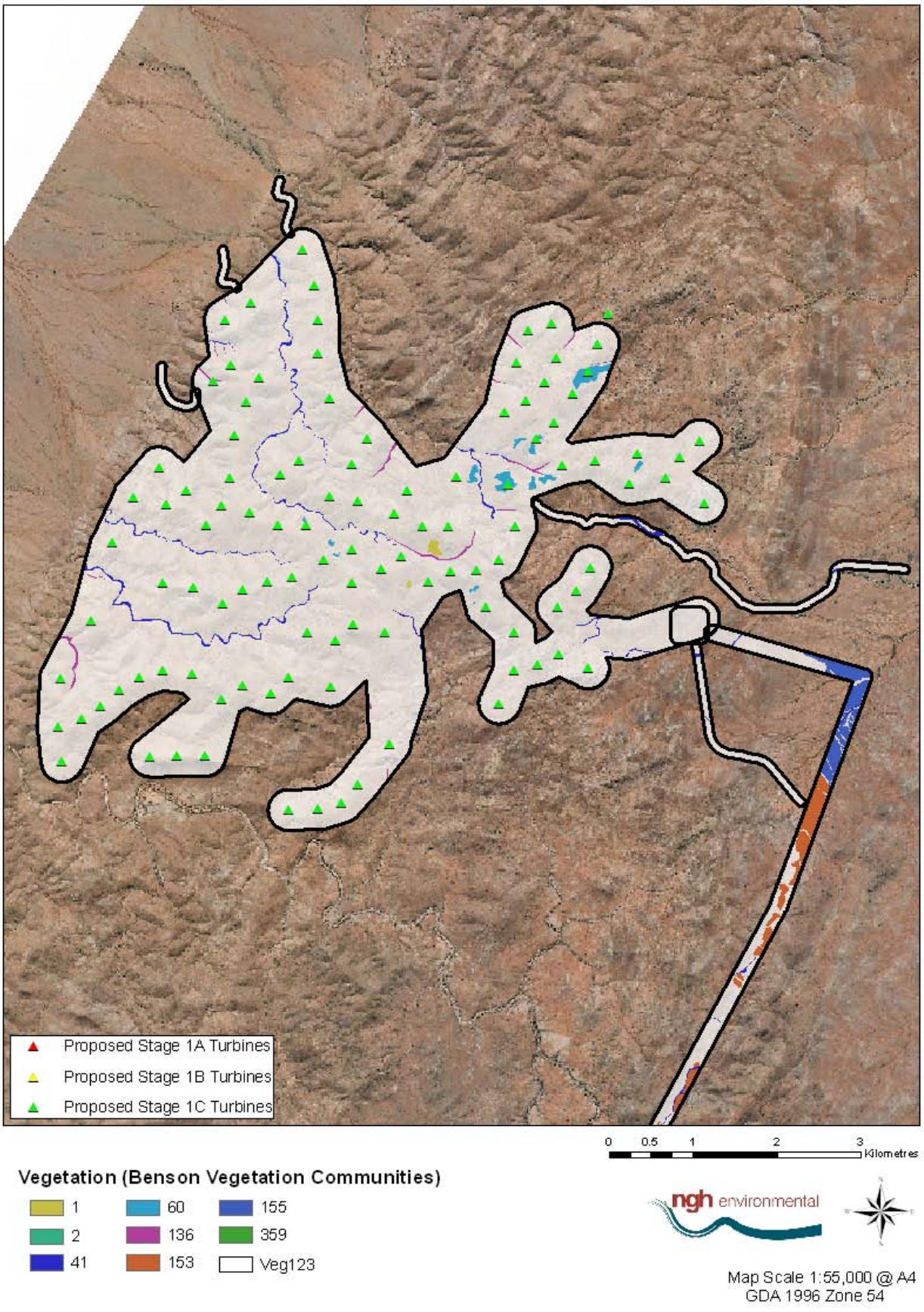
[5] As the precise location of some infrastructure has not yet been determined, vegetation subtotals do not equal the total impact area



Map 7.1: Extent of vegetation communities with the infrastructure overlain



Map 7.2: Extent of vegetation communities with the infrastructure overlain



Map 7.3: Extent of vegetation communities with the infrastructure overlain

Indirect impacts

Vegetation surrounding the development footprint would be affected by vehicle access and parking, materials laydown and spoil deposition and retrieval. Peripheral impacts may include soil compaction, soil erosion and sedimentation. The works have the potential to introduce and spread weed species. The concrete batch plant and associated flush pit, if used, would alter local subsoil conditions over the medium term.

Pollution risks are associated with the concrete batch plant, fuels and lubricants and construction chemicals used at the site. With appropriate safeguards and practices (refer to the Environmental Assessment), these risks to native vegetation are expected to be low. Similarly, the increased bushfire risks to vegetation caused by construction activities are expected to be manageable and acceptable. Dust would be generated from the excavation and building activities at the construction sites, and by traffic using unsealed access routes, over the construction period. The limited duration of dust deposition is not expected to significantly affect soils and vegetation at the site.

Impacts on threatened species and communities and Vegetation of conservation significance

The impacts of the proposal on the threatened flora species are identified and assessed in the Assessment of Significance presented in Appendix D. Showy Indigo, Creeping Darling Pea and Yellow-keeled Swainsona were assessed via a TSC Act 7-part test. The assessment concluded that the potential for significant impact on these species is low. The assessment also identified a common threat to several species, that being habitat degradation caused by heavy grazing in combination with drought.

An existing access road flanks the two undescribed communities along the proposed transmission line easement which will require some level of widening to permit access. Beyond these specific works, these areas of vegetation should be protected from other impacts and should not be used for infrastructure or materials/equipment laydown.

Additionally, avoiding impact to the vegetation mapped as Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland / low sparse woodland as recommended in the Stage 1a biodiversity assessment is recommended.

Microscale selection of infrastructure placement for tracks and cabling should be undertaken by employing an appropriately qualified ecologist to assist in avoiding any threatened flora species, should they be present during the construction period. This is an appropriate action considering the highly ephemeral nature of many threatened flora species in any semi-arid landscape.

CONCLUSION

In view of the local abundance of the majority of the vegetation communities present and the small development footprint of the development, the proposal is unlikely to have a negative effect on the flora values at the site. Rather, management of current levels of grazing through continued control of feral goats, will aid in the long-term sustainability of the vegetation communities within the study area, and potentially further into the surrounding locality as grazing by feral goats is considered a threat to the vegetation communities of western NSW. This management activity would allow recruitment of species currently subject to intensive grazing, and increase vegetative cover over the entire site. This is considered to be a net gain.

The following general and project specific measures are recommended to ensure that the flora values and vegetation communities of the study area are not expected to be significantly affected at the site. In general, if the locations of works (including temporary activities such as concrete batching) are situated in already cleared areas or sparsely vegetated areas, biodiversity impacts in relation to vegetation would not be of a significant level.

General measures

- Site stabilisation and rehabilitation would be undertaken without delay, following the guidelines in the EA

- Works would avoid impacts to mature shrubs and trees wherever possible and would be confined to cleared areas and sparsely vegetated areas as much as possible, avoiding denser shrub and woodland patches
- As a general rule, existing clearings would be used for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and the deposition and retrieval of spoil whenever practicable
- Wherever practical, works would be avoided during, and immediately following heavy rainfall events to protect soils and vegetation at the site
- Any compaction of soil resulting from vehicle access and laying of materials, particularly during saturated soil conditions, would be avoided and remediated as necessary
- Excavated topsoil, subsoil and weathered rock would be stored separately and replaced in a manner that approximates the original profile as closely as possible
- Appropriate fire fighting equipment would be held on site and an appropriate number of people onsite would be trained in its use
- Machinery and vehicles used in construction works would go through a wash zone before and after site access to reduce the introduction and spread of weeds and pathogens
- Laydown sites for excavated spoil, equipment and construction materials would be weed-free or treated for weeds wherever practicable
- Post construction weed monitoring should be undertaken after the first significant rainfall event to ensure that no weed infestations have resulted from the works
- Imported materials such as sand and gravel would be sourced from sites which do not show evidence of noxious weeds or *Phytophthora* infection

Project-specific measures

- **ngh**environmental recommend that infrastructure placement avoid areas of high biodiversity value as identified in Map set 6 where possible. It is acknowledged that an existing access road flanks these communities along the proposed transmission line easement which will require some level of widening to permit access. Beyond these specific works, these areas of vegetation should be protected from other impacts and should not be used for materials/equipment laydown. The implementation of a feral goat management program as part of the development of the wind farm site would assist in offsetting environmental impacts and halt the degradation that heavy goat grazing is causing across many areas of the site including these vegetation communities.

- Contractors and staff should be made aware of the significance and sensitivity of the two significant vegetation communities not present in the Stage 1a study area (Mulga/Red Mallee shrubland on rocky slopes of the Barrier Range, and Chenopod - Red Mallee woodland / shrubland on gravelly lower slopes. Similarly, areas of Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland / low sparse woodland present in the Stage 1b area should follow a similar prescription. An existing access road flanks these communities along the proposed transmission line easement which will require some level of widening to permit access. Beyond these specific works, these areas of vegetation should be protected from other impacts and should not be used for materials/equipment laydown.
- Contractors and staff would also be made aware of the threatened flora species that may occur within the study area disseminated in ‘toolbox’ talks should any become present during the construction period by an appropriately qualified person. This is appropriate considering the highly ephemeral nature of many threatened flora species particularly after rain events in a semi-arid landscape.
- Works would avoid impacts to mature shrubs and trees wherever possible and should be confined to cleared areas and sparsely vegetated areas as much as possible, avoiding denser shrub and woodland patches

- Weed and sediment erosion controls should be implemented to prevent degradation to native vegetation during and following the proposed works. A Construction Environmental Management Plan would be the appropriate framework for these controls
- All areas of disturbed soil should be rehabilitated progressively as soon as practicable after disturbance, in order to resist erosion and colonisation by weeds. Design and implementation of specific erosion and sediment controls will be required to ensure that landforms are not destabilised and erosion is not increased onsite. This may rely on physical controls such as netting to stabilise slopes. Landforms in many areas are steep and unstable and as such revegetation is unlikely to be possible. Means to trap soil and moisture and stabilise slopes will provide the best potential for natural regeneration in the long-term
- Where cement is included in cable trench backfill, at least 20 centimetres of cement-free topsoil would be replaced as the top layer in the backfill

4.1.2 Operational impacts

The operational impacts of the proposal may include the way fauna currently use the turbine sites, including alteration to the prevailing detrimental grazing regime, with resultant benefits to native flora. Impacts may include changes in the level of biomass and species composition. Inspection, maintenance and monitoring would be required to maintain the infrastructure, although existing tracks would be used and impact on vegetation is expected to be minimal.

- Access tracks would be maintained to minimise ongoing erosion and sedimentation impacts
- The maintenance program would also include regular inspections for goats. If any noxious weeds are identified, the relevant landholder should be notified of their location for their control.
- Maintenance access would be confined to existing tracks, hardstand or heavily disturbed areas
- The impacts of major repairs would be similar in nature to construction impacts, but more limited in extent
- There would be an ongoing low-level pollution risk from the oil-cooled substation. However, design measures would be incorporated to ensure that any spill would be contained by bunding and the spill treated expeditiously

4.1.3 Decommissioning impacts

Decommissioning impacts would be similar but not as extensive as construction impacts. The area of impact would be reduced because underground footings and cabling would not be removed from the site. The decommissioning phase of the proposal may temporarily affect the use of habitat at the site by fauna, but is not expected to significantly affect local floral populations in the medium-long term.

nghenvironmental recommend the following measures to address operational impacts of the proposal:

- A flora assessment would be undertaken prior to decommissioning to identify biodiversity constraints
- Weed and sediment erosion control principles should be developed and implemented
- Disturbed ground should be stabilised and rehabilitated as soon as practicable after works
- Access tracks would be upgraded as required and appropriate weed hygiene and rehabilitation measures would be implemented

4.2 Fauna and fauna habitat

The development of the Stage 1b and 1c areas of the proposed Silverton wind farm would result in a number of impacts to local biodiversity. These can be considered in terms of the three phases of the development: construction, operation and decommissioning.

4.2.1 Construction impacts

HABITAT LOSS AND MODIFICATION

Table 4 summarises the areas of impact that would be associated with the development of the Stage 1b and 1c wind farm during infrastructure construction. It is noted that cabling between turbines may be installed within the access road easement and therefore may not necessitate additional disturbance.

The ridges and upper slopes are used by a variety of fauna species, but specifically reptiles, birds, macropods, goats and rabbits. Removal of habitat in ridge locations would include substrate for reptiles and small mammals. Larger trees provide habitat for birds, particularly perch sites for Wedge-tail Eagles and other raptors, with some of these requiring removal. Track and turbine footprints would be discrete and are not likely to substantially alter the foraging and refuge habitat available to most species. However, for rock outcrop and spinifex specialist development of these habitats will reduce areas of habitat. A detailed assessment of the rock-obligate Tawny Rock Dragon will be provided in an additional report..

The routing of the powerline from Mt Robe to the southern section is predominantly through lower ridges and rolling plains and substantially along an existing track. This infrastructure would require a discrete loss of habitat including trees and shrubs. Vegetation is generally sparse in this landscape and the overall pattern and extent of clearing is unlikely to have an adverse effect on local fauna. Conversely, the management of feral goats is likely to have a positive impact on fauna habitat.

DUST, NOISE AND VIBRATION

The installation of tracks, turbines, cable laying and associated infrastructure would generate temporary impacts. The dust, noise, vibration and activity associated with the construction phase may temporarily affect the foraging behaviour of local fauna species, particularly birds and macropods. Trenches required for the installation of cabling, predominantly within access roads, will present a trap hazard for local fauna for the time that they are open. Given the local abundance of similar habitat, this temporary effect on habitat utilisation is not likely to significantly affect local populations of these generally highly mobile species.

POLLUTION RISK

The concrete batch plant, construction activities using concrete and the storage and use of fuels, lubricants and construction chemicals carries a pollution risk. In general, if the locations of works (including temporary activities such as concrete batching) are situated in already cleared areas or sparsely vegetated areas, biodiversity impacts should be low.

To ensure impacts are minimised, **ngh**environmental recommend the following measures:

- Recommendations made within the initial Biodiversity Assessment (**ngh**environmental 2008a) should be adopted for the Stage 1b and 1c areas where appropriate
- Infrastructure should be confined to cleared areas and/or sparsely vegetated areas as much as possible, avoiding denser shrub and woodland patches
- A buffer should apply to mature hollow-bearing trees to ensure indirect impacts (such as noise and dust) are minimised where practical
- Further survey of substantial rock outcrops will be completed during November/December 2008 to make an adequate assessment of rock-obligate fauna such as the Tawny Rock Dragon and their habitats

- Clusters of rocks and boulders should be avoided where possible. Where rocks and boulders cannot be avoided, they should be placed directly adjacent to the works area to preserve the availability of refuge
- Standing dead trees and woody debris should be avoided where possible. Where they require removal to allow for the tracks and hardstand areas, they should be placed adjacent to the impact areas, to retain these refugia in the immediate area
- A suitably qualified ecologist should be onsite during construction to ensure that if any habitat features do require removal or modification, that they are first inspected for signs of fauna, and any fauna species can be removed to adjacent areas of habitat
- Trenches required for the installation of cabling would be open for the minimal period achievable. They would be checked at first light and any trapped fauna removed by an appropriately qualified person
- Weed and sediment erosion controls should be implemented to prevent onsite habitat degradation during and following the proposed works. A Construction Environmental Plan would be the appropriate vehicle for these controls
- All areas of disturbed soil should be rehabilitated progressively as soon as practicable after disturbance, in order to resist erosion and colonisation by weeds. Design and implementation of specific erosion and sediment controls will be required to ensure that landforms are not destabilised and erosion is not increased onsite. This may rely on physical controls such as netting to stabilise slopes. Landforms in many areas are steep and unstable, which combined with the arid environment introduces significant issues in relation to revegetation. Means to trap soil and moisture and stabilise slopes will provide the best potential for natural regeneration in the long-term

4.2.2 Operational impacts

The key operational impacts of the proposal relate to the operation of the wind turbines. The potential bladesweep height of the turbines could range from approximately 34 to 155 metres above the ground, at a diameter of approximately 45m (equivalent bladesweep area approximately 6,359m^2). The impacts of the wind farm would be most acutely felt by those species utilising aerial habitat within the bladesweep zone; birds and microchiropteran bats. Other terrestrial fauna may be affected by turbine noise and blade flicker, although, given the low fauna diversity and abundance at the site, these latter impacts are likely to be limited.

AVOIDANCE AND COLLISION RISKS

For birds and bats using the aerial habitat of the bladesweep zone, there are two types of risk posed by the operational turbines.

i. Collision with wind turbines, or 'bladestrike'. For these purposes, 'bladestrike' refers to mortality caused by direct collision with turbine blades and by birds being swept down by the wake behind a turbine blade. The significance of the mortalities is species-specific. If the species is at low density in the landscape or susceptible to multiple collision events (such as for flocking species), collisions may threaten a local population. If the species is a top order predator or key stone species, there may be ecological ramifications for other species

ii. 'Avoidance' behaviour caused by the presence of the turbines and associated infrastructure. Depending on where the turbines are located, this may affect foraging patterns, nesting, roosting or movements around the site. It can be considered equivalent to a loss or modification of habitat for some species and therefore can have resultant impacts on the carrying capacity of the site

A qualitative risk assessment for birds and bats, combining assessments of likelihood and consequence, was carried out to produce a final risk rating of 'low', 'moderate' or 'high' risk for selected species (refer to discussion and full evaluation, Appendix E). Likelihood incorporates biological, behavioural and environmental risk factors. Consequence includes the significance of bladestrike and habitat loss in terms of habitat rarity and importance, population impacts, recovery

potential and species conservation status. A distinction is drawn between the significance of impacts to individuals of a species and impacts to the wider population. The assessment draws on the Interim Standards for Risk Assessment relating to birds and wind farms (Brett Lane and Associates 2005) and the Australian Standards for Risk Assessment (AS/NZS 4360) and Environmental Risk Management (HB203:2000). The risk assessment is summarised below.

Table 5: Overall impact risk for bird and bats (bladestrike and avoidance impacts)

The risk assessment focuses on bird groups which have been shown to be at particular risk in studies at operational wind farms (raptors, waterbirds, migratory species), as well as rare, threatened or protected species with potential to be present in the study area. They are listed in order of decreasing risk to a local population.

Species	Risk to individuals at site	Risk to population
Wedge-tailed Eagle	Moderate	Moderate-high
Brown Falcon	Moderate	Moderate
Diamond Firetail	Low	Moderate
Parrots: Superb Parrot, Turquoise Parrot, Scarlet-chested Parrot	Low	Moderate
Pink Cockatoo	Low	Moderate
Ducks: Blue-billed Duck, Freckled Duck	Low	Moderate
Owls: Barking Owl, Masked Owl, Grass Owl, Barn Owl	Low-moderate	Low-moderate
Bats: Yellow-bellied Sheathtail-bat, Inland Forest Bat, Little Pied Bat	Low	Low-moderate
Australian Hobby	Moderate	Low
Spotted Harrier	Moderate	Low
White-throated Needle-tail	Low-moderate	Low
Australian Kestrel	Low-moderate	Low
Peregrine Falcon	Low-moderate	Low
Tawny Frogmouth	Low	Low
Painted and Pied Honeyeater	Low	Low
Painted Snipe, Latham's Snipe	Low	Low
Egrets: Cattle Egret, Great Egret	Low	Low

nghenvironmental recommend the following measures to address operational impacts of the proposal:

- It is understood that CASA will likely require lighting of a particular specification. If required, marker lights should be minimised in number and fitted to reduce their ability to attract migrating birds and insects (red lights are preferable, with the least number of flashes per minute, cowls could be used to shield the light when viewed from the ground and reduce

potential to attract wetland birds taking off at dusk). These modifications will require the approval of CASA

- Guy lines should not be fitted to towers or associated structures, where possible
- The design adopted for use on the turbine towers should not provide perching opportunities
- Electrical connection lines should be installed underground where possible
- Power poles should be designed to minimise perching and roosting opportunities where practical
- Power poles and overhead powerlines should be designed to reduce impacts to birds (for example by using flags or marker balls, large wire size, wire insulation, wire and conductor spacing) in areas of elevated risk of bird strike
- To reduce the attractiveness of the site to foraging raptors, goats should be controlled onsite and carrion should be removed from beneath turbines as quickly as possible
- An adaptive management monitoring program should be designed to document mortalities, remove carcasses and assess the effectiveness of controls. Timing should be specific to the most at-risk target species. Standardised and publicly available data should be collected to increase the knowledge base on this subject. If mortalities exceed a pre-determined threshold (set out in the monitoring program), additional mitigation measures should be considered, such as diversion structures, blade painting (refer Hodos *et al.* 2001), turning off turbines at critical times, further turbine ridge habitat modification and enhancement of off-site habitats
- There would be benefits for several subject species in controlling heavy grazing by feral goats onsite. Implementation of a feral goat management program as part of the development of the wind farm site would assist in offsetting environmental impacts and halt the degradation that heavy goat grazing is causing across many areas of the site

THREATENED SPECIES WITH POTENTIAL FOR IMPACT

An evaluation of species of conservation significance with potential to be affected by the proposal was undertaken using searches from the Bionet search tool (Broken Hill Complex Bioregion) and EPBC search engine (30km buffer). From this, and author experience, twenty-nine species were evaluated as having potential to be affected:

Birds

Thick-billed Grasswren	Rufous Fieldwren
Pink Cockatoo	Scarlet-chested Parrot
Painted Honeyeater	Pied Honeyeater
Rainbow Bee-eater	White-throated Needle-tail
Barking Owl	Masked Owl
Black-breasted Buzzard	Square-tailed Kite
Australian Bustard	Grey Falcon
Fork-tailed Swift	

Mammals

Little Pied Bat	Inland Forest Bat
Kultarr	Forrest's Mouse
Stripe-faced Dunnart	Yellow-bellied Sheathtail-bat
Sandy Inland Mouse	Yellow-footed Rock Wallaby
Long-haired Rat	

Reptiles

Tawny Rock Dragon	Slender Mallee Blue-tongue Lizard
Ringed Brown Snake	Marble-headed Snake-lizard
Woma	

Guided by state and commonwealth legislation, 'assessments of significance' were undertaken to properly characterise the potential impacts on all species with the exception of the Tawny Rock Dragon (Appendix D). These assessments concluded that with the adoption of recommendations and mitigation measures, the potential for the proposed works to generate lifecycle impacts sufficient to affect local viable populations will be avoided. The risk relates to:

1. Loss or modification of important habitat - six species

   (Tawny Rock Dragon, Ringed Brown Snake, Slender Mallee Blue-tongue Lizard, Marble-headed Snake-lizard, Woma, Yellow-footed Rock Wallaby)
2. Ongoing collisions with turbine infrastructure – 12 species

   (Pink Cockatoo, Scarlet-chested Parrot, Painted Honeyeater, Pied Honeyeater, Masked and Barking Owls, Grey Falcon, Black-breasted Buzzard, Square-tailed Kite, Inland Forest Bat, Yellow-bellied Sheathtail-bat, Little Pied Bat)

The assessment identified habitat and habitat features important to threatened species onsite as rocky outcrops, Spinifex grasslands and the Barrier Range ridge system (for wide ranging raptors). The assessment also identified a common threat to several species, that being habitat degradation caused by heavy grazing from feral goats in combination with drought, along with fox predation. Specific mitigation measures were developed based on identified impacts and have been included in Section 4.

On the basis of these measures, it is considered, with the exception of the Tawny Rock Dragon, unlikely that no species or community listed under the NSW *TSC Act* or Commonwealth *EPBC Act* are likely to be subjected to a significant adverse impact.

With the effective implementation of these measures, **ngh**environmental consider that not only can a significant impact on the subject species be avoided but across the site habitat improvement will result in a net gain to biodiversity.

An assessment of significance on the Tawny Rock Dragon (*Ctenophorus decressi*) will be completed once properly timed surveys and habitat assessment are undertaken (November/December 2008). The results of which, will be provided in an additional report.

4.2.3 Decommissioning impacts

Decommissioning impacts would be similar but not as extensive as construction impacts. The area of impact would be reduced because underground footings and cabling would not be removed from the site. Access tracks would be upgraded as required. The decommissioning phase of the proposal may temporarily affect the use of habitat at the site by fauna, but is not expected to significantly affect local fauna populations in the medium-long term.

nghenvironmental recommend the following measures to address operational impacts of the proposal:

- A fauna assessment should be undertaken prior to decommissioning to identify biodiversity constraints
- Weed and sediment erosion control principles should be developed and implemented to protect fauna habitat
- Disturbed ground should be stabilised and rehabilitated as soon as practicable after works

5 CONCLUSIONS

As discussed in **ngh**environmental (2008a), a number of environmental gains are associated with wind farm development. Nonetheless, the proposal poses several risks to local biota if not properly managed or mitigated.

This assessment has identified important habitats and habitat features onsite as well as several threatened species with potential to be adversely impacted either directly or indirectly by the proposal. These impacts are considered to be manageable with the effective implementation of measures stated in this report.

This report has also established that there would be benefits for several subject species in controlling heavy grazing by feral goats onsite. Implementation of a feral goat management program as part of the development of the wind farm site would assist in offsetting environmental impacts and halt the degradation that heavy goat grazing is causing across many areas of the site. grazing is causing across many areas of the site. The implementation of the goat management plan would have the potential to significantly improve biodiversity across the site.

The key mitigation strategies considered necessary to reduce the potential impacts to an acceptable level are outlined in Section 4 of this report. On the basis of these measures, with the exception of the Tawny Rock Dragon, no species or community listed under the NSW *TSC Act* or Commonwealth *EPBC Act* are considered likely to be subjected to a significant adverse impact.

It is recommended that a study on the population status and distribution of the Tawny Rock Dragon be undertaken for the Stage 1b and 1c areas. This will enable an adequate assessment of rocky outcrops identified as potential constraints (**ngh**environmental 2008b) and provide information specific to an assessment of the potential impacts to the Tawny Rock Dragon.

6 ASSESSMENT PERSONNEL

The following personnel contributed to the field surveys and writing of this assessment.

Name	Role	Specialist skills and abilities
Nicholas Graham-Higgs	**Project Director – Project management and senior review**	Nicholas has worked as an environmental planning and resource consultant since 1992, specialising in natural resource management. A wide range of assignments covering diverse natural and modified environments, have enabled Nick to develop a broad knowledge base in the area of natural resource planning and management. Nick is accredited as a Certified Environmental Practitioner by the Environment Institute of Australia and New Zealand.
Brooke Marshall	**Project Manager - Internal review**	Brooke is a first class honours Natural Resources graduate of the University of New England (UNE). She specialised in wildlife management, ecosystem rehabilitation and natural resource management in developing countries. Brooke has prepared impact assessment and biodiversity assessment reports relating to a variety of infrastructure development (including roads, windfarms, telecommunications, water supply management and residential development) as well as river modification and prescribed burning works. These reports have included threatened floral and fauna species assessments, research, fieldwork and GIS components. Her major projects have included design of monitoring program for a potentially threatened population of Yellow-bellied Gliders on the South Coast, impact assessments and biodiversity assessments for a number of wind farm developments on the Southern Tablelands, a Species Impact Statement involving 33 subject species near Eden, and strategic biodiversity planning reports for the Snowy River Shire and Bega Valley Shire.

Name	Role	Specialist skills and abilities
Steven Sass B. App. Sci. (Env.Sci) (Hons) CSU	**Senior Ecologist/ Senior Author**	Steven joined **ngh**environmental in August 2006 with expertise in environmental consulting and biodiversity assessment. In the four years prior, he played a key role at Charles Sturt University, undertaking flora and fauna impact assessment for the Johnstone Centre (Environmental Consulting) and as a senior research officer within the biodiversity research and education team with much of his work in western NSW. Steven is an experienced ecologist having undertaken more than 400 aquatic and terrestrial threatened flora and fauna surveys and habitat assessments. His ecological expertise is used to design and implement landscape scale biodiversity surveys. These include studies of frog and reptile populations in the Murrumbidgee Irrigation Area (over 200,000 hectares) through surveys and habitat assessments at 160 sites, terrestrial biodiversity surveys and habitat assessments in the Upper Billabong Creek Catchment Area (around 30,000 hectares) and the impact of fire on biodiversity in a large reserve system (over 250,000 hectares) in western NSW. Steven has also managed numerous biodiversity assessments for large mining developments in western NSW and was the senior author for the Stage 1 Biodiversity Assessment. Steven has extensive experience and knowledge of the threatened species of western NSW having undertaken research and monitoring on a variety of species with a focus on threatened species management. He is an Adjunct Associate of the Ecology and Biodiversity group within the Institute for Land, Water and Society, a leading research group at Charles Sturt University, Australia's largest regional university and is accredited as a Certified Environmental Practitioner by the Environment Institute of Australia and New Zealand.

Name	Role	Specialist skills and abilities
Kelly Simpson B.Sc (Env) USYD	**Botanist**	Kelly is currently completing a Masters in Environmental Management majoring in vegetation management and botany. Kelly has over 3 years professional experience in environmental management and vegetation rehabilitation. Kelly has previous experience as an environmental consultant with a large Sydney based firm. During this time Kelly worked on a number of projects including a multi-million dollar Defence project. She has gained extensive experience managing environmental projects, conducting field works and preparing environmental management plans. Since joining **ngh**environmental Kelly has been involved in the preparation of Reviews of Environmental Factors and Environmental Impact Statements. Kelly has 2 years experience as a team leader with a bush regeneration company. During that time, she gained an extensive knowledge of native flora species within the Sydney Basin area as well as the principles behind native vegetation restoration. Kelly has a good understanding of the types of control techniques appropriate for different noxious and environmental weeds. She has compiled flora species lists, weed management plans and rehabilitation plans for a number of public reserves within the Pittwater and Warringah Local Government Areas. Kelly has experience in the flora of arid and semi-arid environments having recently conducted vegetation community surveys between Broken Hill and Mildura.
Dr Ian Sluiter BSc (Hons), PhD, Monash	**Botanist**	Dr. Sluiter has had 20 years experience in the research and management of Australia's natural resources. The past decade has seen Dr. Sluiter concentrate on monitoring, research and on-ground management of the flora and fauna of southeastern Australia. Prior to forming Ogyris Pty Ltd. in 1995, he had been the Mallee Senior Scientist (Flora, Fauna & Fisheries) with the former Dept. of Natural Resources & Environment (now DSE) based at Mildura. His research and management experience of threatened species and communities and knowledge of the semi-arid and arid flora and fauna of southeastern Australia is especially well regarded. He is a past Chairman of the Malleefowl Recovery Team and author of recent major reviews on the floristic definition and conservation status of threatened southeast Australian Buloke Woodlands and the vegetation – kangaroo grazing relationships at Hattah-Kulkyne National Park. Dr. Sluiter is a consultant to the Victorian, South Australian and New South Wales Governments, the Murray-Darling Basin Commission, SA Water and Lower Murray Water on the influence of groundwater on Mallee region terrestrial, riparian and aquatic environments and provides ecological impact assessments of new sand mining and horticultural developments that are currently occurring within the Murray-Darling Depression IBRA Bioregion.

Name	Role	Specialist skills and abilities
Jim Reside Cert.App.Sci, Conservtion, Res Mgt Ass.Dip.Res Mgt	**Ecologist**	Jim has more than 30 years experience in wildlife ecology and his main interests lie in mammalian fauna of the arid and semi-arid zone. Jim also has extensive experience in rock wallabies and play a key role in the Victorian Brush-tailed Rock Wallaby Recover Plan. Jim is the Director of Wildlife Unlimited, a wildlife ecology consulting company based in Gippsland, Vcitoria.
Nina Trikojus BSc Latrobe	**Ecologist**	Nina works as an ecologist for Wildlife Unlimited. Nina plays an important role in the Brush-tailed Rock Wallaby Recovery Plan by providing field expertise and data analysis.
Amy Currey B.App.Sci (Parks, Recreation & Heritage), B.App.Sci (Ecotourism) CSU	**Ecologist**	Amy graduated from Charles Sturt University with a double degree in Bachelor of Applied Science (Parks, Recreation and Heritage) and (Ecotourism), majoring in Wildlife Ecology and Management. She is currently enrolled to complete a Graduate Certificate in Ornithology, also with Charles Sturt University. Amy has over 18 months professional experience in environmental management, planning and biodiversity surveys. Amy has 2 years experience in biodiversity surveys and assessments with a focus on avifauna surveys. During this time, she has gained extensive experience in undertaking surveys of birds, mammals, reptiles and amphibians, co researched the post fire avifauna monitoring program within the Pilliga region and undertaken full fauna surveys within a number of National Parks and reserves across NSW and northern Victoria. Amy was also a team member of Tawny Rock Dragon surveys across the study area in 2007.
Tim Browne B.Sc (Earth & Env) UTS, M Env Mgt UNE	**Spatial Analyst**	Tim completed a Bachelor of Science (Earth and Environmental) at the University of Technology, Sydney and a post graduate Master of Environmental Management at the University of New England. He enjoys a keen interest in all aspects of Environmental Impact Assessment, Environmental Management and Planning. Prior to his employment with **ngh**environmental, Tim gained consulting experience in environmental impact assessment, contaminated land investigation and remediation; as well as experience within the mining industry in Western Australia. Since commencing work with **ngh**environmental, Tim has prepared and assisted in the preparation of a number of GIS mapping projects including Constraints Analysis and broad scale vegetation mapping. Tim undertakes the majority of the mapping requirements in a multi-faceted consulting company. Tim also has had field experience in environmental impact assessments, biodiversity assessments including terrestrial fauna and flora and fauna surveys and contaminated site investigations. Tim is also an active member of the Environment Institute of Australia and New Zealand and The Geological Society of Australia.

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APPENDIX A: FLORA SURVEY RESULTS

A total of 194 vascular plant species were recorded during the flora survey, 20 of which are introduced species.

Abundance ratings in each column for each vegetation community (refer methods for details). Species of conservation significance are **bolded**. Introduced species are denoted by an asterisk (*). Noxious weeds declared for the Unincorporated and Broken Hill control area under the *Noxious Weeds Act 1993* are indicated with a 'N and their noxious weed class in parenthesis. Incidental sightings of flora species during the field survey outside of the survey locations are indicated with a '#' symbol. Where uncertainty exists due to the unavailability of mature reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only. Botanical nomenclature follows G.J. Harden (ed) (1990-2002) Flora of New South Wales, UNSW Press, except where recent changes have occurred.

	Flora surveys in each Benson Community ID	123	123	123	123	NEW1	123	41	136	NEW2	NEW1	359	123	123	123	123	41	153	153	155	136	123
Scientific name	**Common name**																					
TREES																						
Acacia anuera	Mulga	2		4	3	2	1	1	3		3	2	3	3	1	2				2		4
Acacia euthycarpa	Wallowa								1													
Acacia oswaldii	Umbrella Wattle								1	2							1		1			
Acacia sp.					1		1															
Acacia sp. aff. aneura	Mulga sp. 2												4	4		3						2
Alectryon oleifolius ssp. *canescens*	Western Rosewood					2	1			2	1		1	1								
#Callitris glaucophylla	**White Cypress Plne**																					
Eucalyptus camaldulensis	River Red Gum							4									4					
Eucalyptus dumosa	Dumosa Mallee									2	1											
Eucalyptus gillii	**Curly Mallee**														1							
Eucalyptus intertexta	Gum Coolibah					2	3		1			3				2						
Eucalyptus socialis	Red Mallee					3				4	3	4										
Grevillea striata	Beefwood,													1	1							
Hakea leucoptera	Silver Needlewood																1					
Pittosporum angustifolium	Weeping Pittosporum											1										
SHRUBS																						
Abutilon fraseri	Dwarf Lantern-flower				1		1					2			1		1					
Abutilon leucopetalum								2				2										
Acacia sp. aff. havilandiorum	Needle Wattle						1			1	1											
Acacia tetragonophylla	Dead finish	1		1	1				3	2	2	1	1	1	3		1			2	1	3
Acacia victoriae	Prickly Wattle							1	3									3	1	2	4	
Arabidella trisecta								1	1		1									1	1	
Atriplex limbata																			1			
Atriplex lindleyi																			1			
Atriplex sp						1										2						
Atriplex stipitata	Mallee Saltbush				2				1	2	2	1					1		1	2	1	
Atriplex suberecta	Sprawling Saltbush																		1			
Atriplex vesicaria	Bladder Saltbush										1											
Cassinia laevis	Cough Bush												1		2	3	1					
Chenopodium curvispicatum										1												
Chenopodium desertorum subsp. desertorum											1											
Chrysocephalum apiculatum	Common Everlasting					1		2														
Chrysocephalum semicalvum	Hill Everlasting	3	2	1	2			1	1	1	2		1		2	3				1		
Dodonaea lobulata	A hopbush	1				5	5	3		2	4	1	1		3	1	2				1	2
Dodonaea viscosa subsp. mucronata	A hopbush							1									1					
Einadia nutans	Climbing Saltbush					2	1															
Enchylaena tomentosa	Ruby Saltbush	2				2	1			2	2	4								2	2	3
Eremophila alternifolia		1	1					1		1												
Eremophila oppositifolia ssp. oppositifolia			1							1	2	1										
Eremophila serrulata					1			1														
Eremophila sturtii	Turpentine									1										3		
Leiocarpa tomentosa																					4	
Leiocarpa websteri																			1	1	1	
Lycium australe	Australian Boxthorn										1											
**Lycium ferocissimum (N4)*	African Boxthorn						1	1												1		
Lysiana exocarpi									2													
Maireana brevifolia	Small-leaf Bluebush				1		1											2		1	1	
Maireana georgei	Slit-wing Bluebush								2	2	2											
Maireana pyramidata	Black Bluebush									1	2	1						4	4	3	4	
Maireana sclerolaenoides										3	2	1							1	1	2	
Maireana sedifolia	Pearl Bluebush									2	1	1								2		
Maireana trichoptera										3		2										
Maireana triptera	Three-wing Bluebush							1	2	2	1	2										
Malva parviflora	Small-flowered Mallow		1																			
Minuria cunninghamii											1						1		1	2	2	
Myoporum montanum	Western Boobialla							1	1										1	1	2	
Myoporum platycarpum subsp. perbellum										3												
Olearia decurrens							2				1											
Olearia muelleri	Mueller's Daisy Bush									3												
Olearia pimeleoides																			1			
Pterocaulon sphacelatum	Fruit-salad Plant																				1	
Ptilotus obovatus var. obovatus	Silver Tails	3	2	2	3	2	3	2	2	2	2	2	3	4	5	3	3		1	2	1	3
Rhagodia spinescens	Spiny Saltbush							2		2	2	1						2		3	4	

	Flora surveys in each Benson Community ID	123	123	123	123	NEW1	123	41	136	NEW2	NEW1	359	123	123	123	123	41	153	153	155	136	123
Scientific name	**Common name**																					
Sclerolaena brachyptera	Short-winged Copperburr																1	1	3			
Sclerolaena decurrens	Green Copperburr																		3		1	
Sclerolaena diacantha	Grey Copperburr				1				1	2		1						1	2	1		
Sclerolaena lanicuspis	Woolly Copperburr				3	1			2	2	2	1									1	
Sclerolaena obliquicuspis	Limestone Copperburr	2	1	1			1			1			1	1					1	1	1	1
Sclerolaena tricuspis	Streaked Copperburr								1	1								3	3		1	
Senecio gregorii																			1			
Senecio magnificus	Tall Yellow-top																				1	
Senna artemisioides	Silver Cassia							1	3	2	3	2										
Senna form taxon 'coriacea'										1	1											
Senna form taxon 'petiolaris'	Woody Cassia									3												
Senna form taxon 'zygophylla'								1		1												
Sida corrugata	Variable Sida	1			1		1	1					2	2	2	2						
Sida intricata	Twiggy Sida																				1	
Sida petrophila	Rock Nightshade				2	2	2	3	3		1	1		3	2	2	3			2	4	3
Solanum ellipticum	Potato Bush	2	2	1	3	1	1	1	2	1	1	2	2	3	3		2		2	2	2	2
Solanum parvifolium								1													1	
Solanum petrophilum	Rock Nightshade	2	1		1								1			1						
Solanum quadriloculatum		1										1										
Teucrium racemosum	Grey Germander					4		2														
FORBS																						
Actinobole uliginosum	Flannel Cudweed	1	1	1	1	1		3					2	3	2	3	2	3	3	3		
**Alyssum linifolium*					1			1														
**Anagallis arvensis*	Blue Pimpernel							1							1	1	2					
Arctotheca calendula	Capeweed		2																		1	
Asperula conferta								3														
Brachyscome ciliaris	Variable Daisy			1		2		2				1	1	2	1		1		1	2	2	1
Brachyscome lineariloba	Hard-headed Daisy				2			2	2		2	2	2	2	2	1	2	2	3	2	2	2
Brassica tournefortii			1	1																		
Bulbine semibarbata	Native Leek				2		1	2			1	1	1	1	1	2	2			1		1
Calandrinia eramaea					1		1	2	2		1		2	2	2	3	2					3
Calandrinia sp.	Purslane												1	1	1	1				1		
Calotis hispidula	Bogan Flea	2	1	2		1	2				1	2	1	4	1	2	2	2	2	2		3
Carrichtera annua	Wards Weed	1			1			2	3	3	3	3								1	2	3
**Carthamus lanatus*	Saffron Thistle				1			1									1				2	
**Centaurea melitensis*	Maltese Cockspur														2							
Chamaesyce drummondii	Caustic Weed														1						1	
Chenopodium murale	Nettle-leaf Goosefoot		1																			
Chthonocephalus pseudevax	Ground-heads															3		2	1	2		
Crassula colorata								2								2	2	1	1		1	
Crassula sieberiana	Australian Stonecrop						1															
Cullen cinereum	Hoary Scurf-pea																					
Cynoglossum australe									1													
Daucus glochidiatus	Native Carrot					2	1	2	2		2	2			2	1	1		1		1	
Dianella longifolia var. *porracea*	Blue Flax-Lily																					
Dissocarpus paradoxus	Cannonball Burr																				1	
**Echium plantagineum*	Pattersons Curse	1			1			1	2		1						2				2	
**Erodium cicutarium*	Common Storksbill	1	2	3			1				1				1					1		
Erodium crinitum	Blue Crowfoot		2	1	2	2	2		2		2	2	2	2	1	2			1	1		2
**Erodium malacoides*																				1		
Goodenia fascicularis	Silky Goodenia															1		2	2		3	
Goodenia pinnatifida					2		2	2	1	1	2							2	1	1		
Goodenia pusilliflora					2		2		2		2	2		1	1	1		2			1	
Gypsophila tubulosa																1		2	2			
Harmsiodoxa blennodioides			1										1		1					1		
**Herniaria cinerea*	Hairy Rupturewort																		1	2	1	
**Hypochaeris glabra*	Smooth Catsear							2								1						
Isoetopsis graminifolia	Grass Cushions				1								2			1	1	2	2	2		2
Ixiochlamys cuneifolia	Silverton Daisy	1	2																			
Lemooria burkittii	Wires-and-wool		1		1						1		3	3		3		3	3	3		3
Lepidium papillosum	Warty Peppercress	3	5	5	2	2	3		2		3	2	3	3	1	2	2	1	1	1		2
Lepidium phlebopetalum		2			2						1								1			
**Limonium lobatum*	Winged Sea Lavender							2	1	2	3	3	1		1	2		2			3	5
Medicago minima	Woolly Burr Medic							1													3	
**Mesembryanthemum nodiflorum*	Small Ice Plant																		1			
Millotia perpusilla	Tiny Bow-flower												1			1		2	2			
Myriocephalus rhizocephalus	Woolly-heads				2		1				2	2		2								

	Flora surveys in each Benson Community ID	123	123	123	123	NEW1	123	41	136	NEW2	NEW1	359	123	123	123	123	41	153	153	155	136	123
Scientific name	**Common name**																					
Omphalolappula concava	Blue burr Stick	2	1	1	1				1		2	2	1	1						2	1	1
Osteocarpum acropterum var. *deminuta*																						
Osteocarpum clandestinum									1													
Oxalis perennans		1	2			2	2	2	1		1				2	2	1				2	
Parietaria debilis	Native Pellitory		1								1		1			1						
Plagiobothrys plurisepalus					2	1							1	1	1	2		2	3			
Plantago turrifera					1									1	1	1						1
Podolepis capillaris	Invisible Plant				1							1					1	1				
Pycnosorus pleiocephalus																						1
Rhodanthe jesseni																	1					
Rhodanthe microglossum		5	1	1	2	1	2	2	2			1	2	2	1		2		1	1	1	1
Rhodanthe moschata													1									
Rhodanthe polygalifolium					1			1			2											
Rhodanthe pygmaea	Pigmy Sunray	1			5		2			1	1	1	3	2	1	1	1	2	3	2	2	2
Rostellularia adscendens var. latifolia								1	2													
**Salvia verbenata*	Vervain																					
Senecio glossanthus											1											
Silene nocturna		1	1			1		2			1		1	1	2	1	2	2	2	1	1	1
Sisymbrium erysimoides	Smooth Mustard	2	2	3		2	2	2	4	2	2	2	2	2	2	1	1		2	2	2	2
**Sonchus oleraceus*	Common Sowthistle							2				1									1	
Stenopetalum lineare	Narrow Thread-petal	1			2					1		3								1	2	2
Stuartina hamata															1		1					
Swainsona fissimontana	Broken Hill Pea																			1		
Tetragonia moorei		1	1	2	1		5	1			1	1	2	2	3	3	2	1	2	2		1
Teucrium sp.	Germander	1	2																			
**Urtica urens*	Small Nettle														3							
Vittadinia cervicularis	Annual New Holland Daisy																			1	1	
Wahlenbergia communis	River Bluebell							2	2								2					
Wahlenbergia gracilenta								2							1	1	3	2	1		1	1
Zygophyllum apiculatum										2	1	1										
Zygophyllum ovatum										2	2	1										
Zygophyllum eremaeum											2											
Zygophyllum iodocarpum											2	3										
GRASSES/SEDGES/RUSHES																						
Aristida sp		1															1					
Austrodanthonia caespitosa	White Top				1								2	1	1	2	2					
Austrostipa drummondi	Drummond's Speargrass					2			1													
Austrostipa nitida	Balcarra Speargrass				1	2	2		1	1								2	2	2	1	
Austrostipa scabra	Rough Spear-grass								1	1									2	2	1	2
Austrostipa sp.	Speargrass	1			3		1	1	1	2	1	1	1	2		4		2	1			
**Bromus diandrus*	Great Brome																				1	
Cymbopogon ambiguus	Lemon Grass							2							1		3					
Cyperus gymnocaulos																	3					
Eragrostis sp.															1	1	2					
**Hordeum leporinum*	Barley Grass																		2			
Juncus flavidus								1														
**Lamarckia aurea*	Goldentop														2	1	2					
Paspalidium constrictum															1							
**Rostraria pumila*					1	1	1	2	1		1		1		1		2	2	2	1	2	
Schismus barbatus	Arabian Grass	1	4	3		2	1	1	2				2	2	2	2	2	2	3	2	2	2
Stipa scabra	Rough spear-grass				1							1										
Themeda australis	Kangaroo Grass							4	3								1				3	
Triodia scariosa	Spinifex Grass							1	3	1		4										
Tripogon loliiformis	Five Minute Grass																	2	4	2	1	
**Vulpia myuros*	Rat's Tail Fescue										1				1		1					1
GEOPHYTES																						
Thysanotus baueri					1						1			1	1	1		2	2	2		2
Thysanotus patersonii	Twining Fringe-lily																			1		
VINES/CLIMBERS																						
Convolvulus graminetinus														2	1	1				1	1	
Glycine clandestina	Twining Glycine						1	3	2						3	2	1				1	
Rhyncharrhena linearis	Purple Pentitrope	1			1								1									

	Flora surveys in each Benson Community ID	123	123	123	123	NEW1	123	41	136	NEW2	NEW1	359	123	123	123	123	41	153	153	155	136	123
Scientific name	**Common name**																					
FERNS																						
Cheilanthes sieberi subsp. *sieberi*	Mulga Fern														1	1						
Ophioglossum polyphyllum	Adder's Tongue															1						
PARASITIC PLANTS																						
Amyema maidenii subsp. maidenii	Pale leaf Mistletoe								1		1			1	1	1						
Amyema miraculosum subsp. boormanii			1								1				1							
Amyema preissi									1													

APPENDIX B: FAUNA SURVEY RESULTS

1. Fauna species list

* Introduced species
Bold Listed as a threatened (Vulnerable or Endangered) or migratory species under NSW Threatened Species Conservation Act 1995 or Environmental Protection and Biodiversity Conservation Act 1999.

Scientific Name	Common Name	2007 surveys	2008 surveys
BIRDS			
Dromaius novaehollandiae	Emu	*	*
Cygnus atratus	Black Swan		*
Tadorna tadornoides	Australian Shelduck		*
Bizura lobuta	Musk Duck	*	*
Anas superciliosa	Pacific Black Duck	*	
Anas gracilis	Grey Teal	*	*
Anas castanea	Chestnut Teal	*	
Tachybaptus novaehollandiae	Australasian Grebe	*	
Phalacrocorax melanoleucos	Little Pied Cormorant		*
Egretta novaehollandiae	White-faced Heron		*
Threskiornis spinicolis	Straw-necked Ibis		*
Milvus migrans	Black Kite	*	
Haliastur sphenurus	Whistling Kite	*	
Accipiter cirrhocephalus	Collared Sparrowhawk		*
Hieraaetus morphnoides	Little Eagle		*
Aquila audax	Wedge-tailed Eagle	*	*
Falco berigora	Brown Falcon	*	
Falco cenchroides	Nankeen Kestrel	*	*
Fulica atra	Eurasian Coot	*	*
Vanellus miles	Banded Lapwing	*	*
Chlidonias hybrida	Whiskered Tern		*
Geopelia cuneata	Diamond Dove	*	
Geopelia striata	Peaceful Dove	*	
Phaps chalcoptera	Common Bronzewing	*	
Ocyphaps lophotes	Crested Pigeon	*	*
Cacatua leadbeateri	**Pink Cockatoo**	*	
Cacatua roseicapilla	Galah	*	*
Cacatua sanguinea	Little Corella	*	*
Nympicus hollandicus	Cockatiel	*	
Barnardius barnardi	Eastern Ringneck	*	*
Northiella haematogaster	Blue Bonnet	*	*
Psephotus haematonotus	Red-rumped Parrot		*
Psephotus varius	Mulga Parrot	*	*
Melopsittacus undulatus	Budgerigar	*	

Scientific Name	Common Name	2007 surveys	2008 surveys
Cuculus pallidus	Pallid Cuckoo	*	
Ninox novaeseelandiae	Southern Boobook	*	
Podargus strigoides	Tawny Frogmouth	*	
Aegotheles cristatus	Australian Owlet-Nightjar		*
Dacelo novaeguineae	Laughing Kookaburra	*	
Todiramphus pyrrhopygia	Red-backed Kingfisher	*	
Merops ornatus	**Rainbow Bee-eater**	*	
Malarus splendens	Splendid Fairy-wren	*	
Malarus lamberti assimilis	Variegated Fairy-wren	*	*
Malarus leucopterus	White-winged Fairy-wren	*	*
Pardalotus striatus	Striated Pardalote	*	*
Pyrrholaemus brunneus	**Redthroat**	*	*
Gerygone fusca	Western Gerygone	*	
Acanthiza apicalis	Inland Thornbill	*	*
Acanthiza uropygialis	Chestnut-rumped Thornbill	*	*
Acanthiza chrysorrhoa	Yellow-Rumped Thornbill	*	*
Acanthiza nana	Yellow Thornbill	*	
Smicronis brevirostris	Weebill	*	*
Aphelocephala leucopsis	Southern Whiteface		*
Acanthagenys rufogularis	Spiny-checked Honeyeater	*	*
Manorina flavigula	Yellow-throated Miner	*	*
Manorina melanocephala	Noisy Miner		*
Lichenostomus virescens	Singing Honeyeater	*	*
Lichenostomus pencillatus	White-plumed Honeyeater	*	*
Certhionyx niger	Black Honeyeater	*	
Certhionyx variegatus	**Pied Honeyeater**	*	*
Grantiella picta	**Painted Honeyeater**	*	
Epthianura tricolor	Crimson Chat	*	*
Epthianura aurifrons	Orange Chat	*	
Epthianura albifrons	White-fronted Chat		*
Microeca fascinans	Jacky Winter	*	
Petroica goodenovii	Red-capped Robin	*	*
Pomatostomus superciliosus	White-browed Babbler	*	*
Pomatostomus ruficeps	Chestnut-crowned Babbler	*	*
Psophodes cristatus	Chirruping Wedgebill	*	*
Cinclosoma castanotus	Chestnut Quail-Thrush	*	
Cinclosoma cinnamomeum	Cinnamon Quail-Thrush	*	
Daphoenositta chrysoptera	Varied Sittella	*	*
Oreocica gutturalis	Crested Bellbird		*
Pachycephala pectoralis	Golden Whistler	*	
Colluricincla harmonica	Grey Shrike-thrush	*	
Rhipidura leucophrys	Willie Wagtail	*	*
Coracina novaehollandiae	Black-faced Cuckoo-shrike	*	*
Lalage suerii	White-winged Triller	*	*

Scientific Name	Common Name	2007 surveys	2008 surveys
Artamus leucorynchus	White-breasted Woodswallow	*	
Artamus superciliosus	White-browed Woodswallow	*	
Artamus personatus	Masked Woodswallow	*	
Artamus cinereus	Black-faced Woodswallow	*	*
Artamus cyanopterus	Dusky Woodswallow	*	
Craciticus torquatus	Grey Butcherbird	*	*
Craciticus nigrogularis	Pied Butcherbird	*	*
Gymnorhina tibicen	Australian Magpie	*	*
Corvus coronoides	Australian Raven	*	*
Corvus mellori	Little Raven	*	
Struthidea cinerea	Apostlebird		*
Chlamydera maculata	Spotted Bowerbird	*	
Anthus novaeseelandiae	Richard's Pipit	*	
Taeniopygia guttata	Zebra Finch	*	*
Passer domesticus	House Sparrow		*
Dicaeum hirundinaceum	Mistletoebird	*	
Hirundo neoxena	Welcome Swallow	*	*
Cheramocca leucosternus	White-backed Swallow		*
Hirundo nigricans	Tree Martin	*	*
REPTILES			
Diplodactylus byrnei	Gibber Gecko	*	
Gehyra variegata	Tree Dtella	*	*
Heternotia binoei	Prickly Gecko	*	*
Rhynchoedura ornata	Beaked Gecko	*	
Strophurus williamsi	Eastern Spiny-tailed Gecko	*	
Delma australis	**Marble-headed Snake-lizard**	*	*
Delma butleri	Spinifex Snake-lizard	*	*
Lialis burtonsi	Burtons Snake-lizard	*	
Ctenophorus decressi	**Tawny Rock-dragon**	*	*
Ctenophorus nuchalis	Central Netted Dragon	*	
Tympanocryptis tetraporophora	Four-pored Earless Dragon	*	
Varanus gouldii	Sand Goanna	*	
Cryptoblepharus pannosus	Wall lizard	*	*
Ctenotus olympicus	no common name	*	
Ctenotus robustus	Robust Ctenotus	*	*
Ctenotus schomburgkii	Barred Wedge-snout Ctenotus	*	*
Cyclodomorphus melanops	**Southern Spinifex Slender Blue tongue**	*	*
Egernia stokesii	Gidgee Skink	*	
Egernia striolata	Tree Skink	*	*
Lerista muelleri	Three-toed Lerista	*	*
Morethia adelaidensis	Chenopod Morethia	*	*
Morethia boulengeri	Boulengers Morethia	*	*
Tiliqua rugosa	Shingleback Lizard	*	*
Tiliqua scincoides	Common blue-tongue	*	

Scientific Name	Common Name	2007 surveys	2008 surveys
Pseudechis australis	Mulga Snake	*	*
Pseudonaja nuchalis	Western Brown Snake	*	
FROGS			
Litoria rubella	Desert Tree Frog	*	
MAMMALS			
Tachyglossus aculeatus	Echidna	*	*
Macropus fulginosus	Western Grey Kangaroo	*	*
Macropus rufus	Red Kangaroo	*	*
Macropus robustus	Euro	*	*
Petrogale xanthopus	**Yellow-footed Rock Wallaby**		*
Saccolaimus flaviventris	**Yellow-bellied Sheathtail Bat**		*
Tarida australis	White-striped Freetail Bat		*
Mormopterus Sp.3	Eastern Free-tail Bat	*	
Mormopterus Sp.4 lpf	Eastern Free-tail Bat		*
Chalinolobus picatus	**Little Pied Bat**	*	
Chalinolobus gouldii	Gould's Wattled Bat	*	
Vespadelus vulturnus	Little Forest Bat	*	*
Scotorepens balstoni	Inland Forest Bat	*	
Nyctophilus sp.	Unidentified Long-eared Bat	*	
**Vulpes vulpes*	Red Fox	*	*
**Felis catus*	House Cat	*	*
**Oryctolagus cuniculus*	Rabbit	*	*
**Canis familaris*	Dog	*	
**Capra hircus*	Goat	*	*
**Ovis aries*	Sheep	*	*
(SFR) Notomys amplus	Short-tailed Hopping Mouse		*
(SFR) Notomys longicaudatus	Long-tailed Hopping Mouse		*
(SFR) Pseudomys gouldii	Goulds Mouse		*
(SFR)Pseudomys australis	Plains Rat		*
(SFR) ***Sminthopsis macroura***	**Striped-faced Dunnart**		*
(SFR) ***Rattus villosissimus***	**Long-haired Rat**		*
(SFR) ***Antechinomys laniger***	**Kultar**		*

(SFR) = Subfossilled remains identified from bones collected from a small cave near Mount Robe by Graham Medlin, Research Associate, Subfossils section, South Australian Museum.

APPENDIX C: THREATENED SPECIES EVALUATION

C.1 Flora

Table C-6: Threatened flora evaluation.

Evaluation of the potential for impact on threatened flora. Species list sourced from the Bionet search tool (Broken Hill Bioregion) and the EPBC Matters of Environmental Significance search tool (using a buffer of 50kms from the site). For each species, the potential for impact has been determined in the last column as either:

Nil No habitat is present for this species in areas that would be directly or indirectly affected by the proposal

Unlikely Suitable habitat is present, but is marginal or would not be greatly affected by the proposal

Possible Suitable habitat is present and would be affected by the proposal (*Assessment of Significance* required to properly evaluate impact).

Species and Status*	Ecology	Presence of habitat	Potential for impact
Acacia carneorum Purple-wood Wattle V v	Grows in grassland and woodland in red, sandy soil; also found in Mulga communities on sand dunes, level sandy sites and alluvial accumulations along watercourses (DECC 2005a). Preferred soils are shallow, calcareous and loamy, and include brown earths, crusty alkaline soils and neutral red duplex soils (DECC 2005a). Observed as common in gregarious groupings on sandhills and ridges (DECC 2005a).	Known to occur in the region. Marginal habitat exists for this species on sandy plains within the development envelope. In these areas, access tracks and a substation would be developed. It was not recorded during extensive surveying of the development envelope but was recorded nearby off Silverton Road in a previous survey.	Unlikely
Acacia rivalis Silver Wattle E	Confined to woodland communities bordering ephemeral creeks and streams and along watercourses, in NSW, growing in a variety of stony soils, often with limestone content (DECC 2005b). In the Western Division, it is thought to be associated with arid shrublands, forested wetlands and semi-arid woodlands and is identifiable at any time of year (DECC 2005b).	Known to occur in the region. Marginal habitat exists for this species along ephemeral drainage lines on plains and in the ranges. In these areas, access tracks and a substation would be developed. This species was not recorded during extensive surveying of the development envelope.	Unlikely
Atriplex infrequens A Saltbush V v	Associated with broad drainage tracts, clay plains and possibly occasionally inundated habitats. Critical habitat components are speculated to be relatively undisturbed and ungrazed drainage lines and plains (DECC 2005c). In the Western Division, it is thought to be associated with arid shrublands, freshwater and saline wetlands and semi-arid woodlands and is identifiable at any time of year (DECC 2005b).	Predicted to occur in the region. Marginal habitat exists for this species on the plains to the east and west of the site and within the central flat area where the substation is proposed. In these areas, access tracks and a substation would be developed. Most of this area has been extensively degraded by a combination of heavy grazing and drought. This species was not recorded during extensive surveying of the development envelope.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
Dysphania platycarpa E	Grows on heavy soils near ephemeral water, generally in clay or mud by fresh water (DECC 2005d). Recorded in Sturt National Park from previously flooded plains within the sandplain. Interstate habitats include claypan margins, sand above the Samphire level of a flooded clay plain, and in Gidgee scrub (DECC 2005d).	Predicted to occur in region. No suitable habitat would be affected directly or indirectly by the proposed works.	Nil
Eleocharis obicis Spike-rush V v	Grows in ephemerally wet situations including roadside drains and depressions, usually in low-lying grasslands (DECC 2005e). Sites include depressions with heavy clay soils on the Lachlan River floodplain, with *Eragrostis australasica, Atriplex vesicaria and A. nummularia* shrublands, low-lying claypans near an irrigation channel, and a shallow open ditch on a low ridge with *Eucalyptus populnea* in red sandy soil over clay. In the Western Division, it is known to be associated with arid shrublands, freshwater wetlands and semi-arid woodlands and is identifiable at any time of year (DECC 2005e).	Known to occur in region. Marginal habitat exists for this species along ephemeral drainage lines on plains and in the ranges. In these areas, access tracks and a substation would be developed. This species was not recorded during extensive surveying of the development envelope.	Unlikely
Indigofera longibractea Showy Indigo E	Grows on rocky hills and in creek beds, in limited numbers in shallow stony soils among rock outcrops. Across its range it occupies a variety of rocky habitats, ranging from creeks to scree slopes and ridges. Preferred soils are skeletal and sandy (DECC 2005f). In the Western Division, it is known to be associated with arid shrublands, including Acacia and Chenopod sub-formations (DECC 2005f).	Known to occur in the region. Suitable habitat is present in many areas within the development envelope. In these areas, tracks, turbines and the substation are proposed. Extensive searches were conducted in the development envelope and this species was not detected.	Possible
Swainsona flavicarinata Yellow-keeled Swainsona E	Grows in deep red sand. Recorded from a roadside on a treeless plain and in Mulga communities on red earths and on stony soils supporting Bladder Saltbush. Also found on sandy plains and ridges, in grassland, and in watercourses and floodplains near creeks or rock holes DECC 2005g). In the Western Division, it is known to be associated with arid shrublands and freshwater wetlands (DECC 2005g).	Known to occur in area. Suitable habitat is present. In these areas, tracks, turbines and the substation are proposed. This species was not detected during extensive searches in the development envelope.	Possible
Swainsona murrayana Slender Darling Pea V v	Known from clay-based soils (including grey, red and brown cracking clays to red-brown earths and loams). Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species (DECC 2005h). Found in remnant native grasslands or grassy woodlands that have been intermittently grazed, this species may require some disturbance (DECC 2005h). In the Western Division, it is known to be associated with arid shrublands, freshwater wetlands, grasslands and semi-arid woodlands (DECC 2005h).	Known from the region. Marginal habitat is present on the plains to the east and west of the site and within the central flat area where the substation is proposed. In these areas, access tracks and a substation would be developed. This species was not detected during extensive searches in the development envelope.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
Swainsona viridis Creeping Darling Pea E	Grows in dry, sandy or stony areas on the banks or in the beds of creeks.. Also collected along a roadside sandplain in sandy-loam soil. Can occur as a 'large and plentiful' population or infrequently (DECC 2005i). In the Western Division, it is known to be associated with arid shrublands, forested wetlands and semi-arid woodlands (DECC 2005i).	Known to occur in region. Found in the Broken Hill area on sandy soils near watercourses. Suitable habitat is present along drainage lines within the development envelope. In these areas, access tracks and a substation would be developed. Not detected during extensive surveying within the wind farm development envelope.	Possible

V Listed as Vulnerable on the *NSW Threatened Species Conservation Act, 1995*

E Listed as Endangered on the *NSW Threatened Species Conservation Act, 1995*

v Listed as Vulnerable on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

e Listed as Endangered on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

C.2 Fauna

Table C-7: Threatened fauna evaluation.

Evaluation of the potential for impact on threatened fauna. Species list sourced from the Bionet search tool (Broken Hill Bioregion) and the EPBC Matters of Environmental Significance search tool (using a buffer of 50kms from the site). Species listed as *E4 Presumed Extinct* have been excluded. For each species considered, the potential for impact has been determined in the last column as either:

Nil No habitat is present for this species in areas that would be directly or indirectly affected by the proposal

Unlikely Suitable habitat is present, but is marginal or would not be greatly affected by the proposal

Possible Suitable habitat is present and would be affected by the proposal (*Assessment of Significance* required to properly evaluate impact).

Species and Status*	Ecology	Presence of habitat	Potential for impact
BIRDS			
Black-breasted Buzzard *Hamirostra melanosternon* V	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. It lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Not a powerful hunter, despite its size, mostly taking reptiles, small mammals, birds, including nestlings, and carrion. Also specialises in feeding on large eggs, including those of emus, which it cracks on a rock (DECC 2005j).	Known to occur in region. This species was not detected during surveys within the development envelope. Several Wedge-tail Eagles were observed nesting and foraging onsite, which may be competitively excluding the presence of this species onsite. Breeding is undertaken near water, making areas around Umberumberka Dam more suitable than the development envelope. The site features suitable foraging habitat for this species. Turbines would represent a collision risk to this species.	Possible
Australian Bustard *Ardeotis australis* E	Inhabits tussock and hummock grasslands, low shrublands and low open grassy woodlands. Breeding now only occurs in the north-west region of NSW. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees. Forages on insects, young birds, lizards, mice, leaves, seeds and fruit. Dispersive, with irregular widespread movements over long distances, likely to be in response to habitat and climatic conditions. Can converge on areas with high mice numbers and in recently burnt areas (DECC 2005u).	Known to occur locally in the Barrier Ranges. It is not likely that resources important to this species would be adversely impacted. However, turbines may represent a collision risk to this species if it travels over the site. A convergence of this species at the site would increase potential level of impact.	Possible

Species and Status*	Ecology	Presence of habitat	Potential for impact
Square-tailed Kite *Lopoictinia isura* V	In NSW, scattered records of the species throughout the state indicate that the species is a regular resident along the major west-flowing river systems. Shows a particular preference for timbered watercourses. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage (DECC 2005k). In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland (DECC 2005k).	Known to occur in the region. However, there are no recordings of the species within the study area. Due to the extent and location of works, it is not likely this species would be affected by this proposal. Mature shrubs and trees should be avoided. Timbered water courses would not be affected. The site features suitable foraging habitat for this species. Turbines would represent a collision risk to this species.	Possible
Grey Falcon *Falco hypoleucos* V	This species inhabits open woodland in inland Australia, chiefly throughout the Murray-Darling Basin. The breeding range has contracted since the 1950s with most breeding now confined to arid areas, believed to be extinct in areas with more than 500mm rainfall in NSW (DECC 2005q). Usually restricted to shrubland, grassland, wooded watercourses and wetlands where surface water attracts prey. Predates primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse.	Known to occur in the region. However, there are no records within the study area and this species was not detected during assessment for the wind farm development envelope. Habitat and foraging resources in the study area are suitable for this species. Turbines would represent a collision risk to this species if it travels over the site.	Possible
Masked Owl *Tyto novaehollandiae* V	This species forages in a range of forest and woodland types but requires large tree hollows for nesting. Forested areas adjacent to areas of dense and sparse ground cover within close proximity are required for foraging (Garnett 1993 & Peake *et al.* 1993). This species also occurs in fragmented forest-pastoral land usually near creek lines and in open grassy woodland.	Not recorded within the study area. Potential nesting and foraging habitat occurs within the study area. Turbines may represent a collision risk to this species if it travels around and over the site.	Possible
Grass Owl *Tyto capensis* *V*	Preferred habitat includes areas of tall grass, including grassy plains, swampy heath, and flood plains. They nest in trodden-down grass.	Not known from the area. The site would represent marginal habitat for this species. Turbines may represent a collision risk to this species if it travels around and over the site.	Unlikely
Barking Owl *Ninox connivens* *V*	Inhabits eucalypt woodland, open forest, swamp woodlands and timbered watercourses, roosting in denser vegetation. Forages on prey including invertebrates, birds and mammals. Territories range from 30 to 200 hectares and birds are present all year.	Predicted to occur in the Barrier Range outwash, fans and plains. Turbines may represent a collision risk to this species if it travels around and over the site.	Possible

Species and Status*	Ecology	Presence of habitat	Potential for impact
Brolga *Grus rubicundus* V	The Brolga is still abundant in the northern tropics, but very sparse across the southern part of its range. Brolgas often feed in dry grassland but dependent on wetlands, especially shallow swamps, where they will forage with their head entirely submerged (DECC 2005r).	There have been many recordings of this species to the north and north-west of the region. However, they occur in this area only as vagrants (M. Herring, Murray Wildlife Pty. Ltd., August 2007). Habitat for this species is poor within the study area. Turbines would represent a collision risk to this species if it travels over the site.	Unlikely
Chestnut Quail-thrush *Cinclosoma castanotus* *V*	Occurs in a wide range of arid and semi-arid habitats including low shrubs and undergrowth of mallee and acacia scrub. Most abundant in areas more recently burnt. Forages on the ground, often among spinifex clumps, on invertebrates, seeds and berries. Ground nesting.	The site is probably too sparsely vegetated for this species. Predicted to occur in the Barrier Range outwash, fans and plains. Turbines may represent a collision risk to this species if it travels around and over the site.	Unlikely
Brown Treecreeper *Climacteris picumnus* *V*	Occupies eucalypt woodlands, usually with an open grassy understorey. Found in mallee and River Red Gum forest bordering wetlands. It is sedentary but gregarious and usually observed in pairs or small groups of eight to 12 birds. Forages in trees and on the ground. Hollows are essential for nesting.	Not known from the area or predicted to occur. Turbines may represent a collision risk to this species if it travels around and over the site.	Unlikely
Gilbert's Whistler *Pachycephala inornata* *V*	Occurs mostly in mallee shrubland, woodlands and River Red Gum forests. Often found in association with an understorey of spinifex and low shrubs. Forages on or near the ground on spiders and insects. Patches of dense understorey shrubs associated with woodland are essential for breeding. Aggregations are sometimes recorded though this species does not make regular large-scale movements.	Not known from the area or predicted to occur. Turbines may represent a collision risk to this species if it travels around and over the site.	Unlikely
Diamond Firetail *Stagonopleura guttata* V	Found in grassy eucalypt woodlands and riparian areas. Feeds exclusively on the ground, on seeds, leaves and insects (especially in the breeding season). Usually encountered in flocks of between five to 40 birds, separating into small colonies to breed, between August and January. Nests are built in shrubs. Appears to be sedentary, though some populations move locally.	The site is probably too sparsely vegetated for this species. Predicted to occur in the Barrier Range outwash, fans and plains. Turbines may represent a collision risk to this species if it travels around and over the site.	Unlikely
Halls Babbler *Pomatostomus halli* *V*	Inhabits dry Mulga scrub with a grassy understorey including spinifex, on ridges and plains with either sandy or stony soils. Occasionally occurs in open dry woodland and eucalypt-lined watercourses. Forages on the ground. Builds nests in low trees and is often observed in flocks of up to 20 individuals.	Not known or predicted for the area. Works would be unlikely to affect this species if present.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
Plains-wanderer *Pedionomus torquatus* E, v	This ground-dwelling species occurs in sparse native grasslands, typically on hard red-brown soils. Grassland structure is important, with a combination of bare earth, fallen timber and forbs required. Solitary individuals or pairs occupy territories of around 12 - 18 hectares.	Not known or predicted for the area. Works would be unlikely to affect this species if present.	Unlikely
Blue-billed Duck *Oxyura australis* V	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached (DECC 2005l). Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies. They are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed (DECC 2005l).	Known to occur in the region. However, all records that exist are well outside the area that would be affected by the proposed works. Turbines would represent a collision risk to this species if movements are undertaken across the site.	Unlikely
Freckled Duck *Stictonetta naevosa* V	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates (DECC 2005m).	Known to occur in the region. However, no records exist within the study area. No suitable habitat is present in areas that would be affected by the proposed works. Turbines would represent a collision risk to this species if movements are undertaken across the site.	Unlikely
Great Egret *Stictonetta naevosa* *m*	The Great Egret is partially migratory. It is found feeding in shallow water or drier habitats on fish, frogs or insects. It breeds in colonies in vegetation near permanent water.	Not observed onsite. Suitable habitat is not present. Turbines would represent a collision risk to this species if it travels over the site.	Unlikely
Cattle Egret *Oxyuro australis* *m*	The Cattle Egret is a wide ranging species, found in dry grassy habitats where it feeds on insects. It is usually found large animals which disturb insects.	Not observed onsite. Suitable habitat is not present. Turbines would represent a collision risk to this species if it travels over the site.	Unlikely
Latham's Snipe *Gallinago hardickii* *m*	A cryptic waterbird, possibly nomadic. Occupies ephemeral wetlands, foraging on seeds and invertebrates at the water's edge. This species is not known to congregate in large numbers.	Not observed onsite. Turbines would represent a collision risk to this species if it travels over the site.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
Painted Snipe *Rostulata benghalensis* E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Feeds on worms, molluscs, insects and some plant-matter. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. Breeding is often in response to local conditions, generally occurring from September to December. The nest consists of a scrape in the ground, lined with grasses and leaves.	No records of this species occur locally although it is predicted to occur in the Barrier Ranges (DECC 2005w). No suitable habitat present for this species in areas that would be affected by the proposed works.	Unlikely
Australian Painted Snipe *Rostulata australis* v	Endemic to Australia. Usually lumped with the Painted Snipe however, differences suggest recognition of a separate taxa may be warranted. Habitat preferences are as for the Painted Snipe.	No records of this species occur locally. No suitable habitat present for this species in areas that would be affected by the proposed works.	Unlikely
Pink Cockatoo (Major Mitchell's) *Cacatua leadbeateri* V	Found across arid and semi-arid inland. In NSW it is found regularly as far east as about Bourke and Griffith, and sporadically further east. Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres (DECC 2005o).	Known to occur in the region with numerous recorded sightings within the Western CMA Region within the Stage 1 Biodiversity Assessment No important habitat resources would be affected for this species. Turbines would represent a collision risk to this flocking species.	Possible
Red-tailed Black Cockatoo *Calyptorhynchus banksii* V, e	Found in a wide variety of habitats. In NSW, one population occurs on the north-western slopes and plains but another small isolated population is found in the coastal north-east. Nests in hollows greater than 2m off the ground and 12cm in diameter. Threats include loss of native forest and riparian vegetation and overgrazing.	Predicted to occur in the Barrier Range outwash, fans and plains by DECC catchment modelling. Turbines may represent a collision risk to this species if it travels around and over the site.	Unlikely
Scarlet-chested Parrot *Neophema splendida* V	Inhabits arid to semi-arid areas, forageing on or near the ground for seeds of grasses, including spinifex, herbs and acacias (DECC 2005v). Usually nests close to the ground within small trees. Populations are eruptive, building up rapidly during favourable years of abundant rainfall. Several pairs may nest within neighbouring trees.	One record occurs south of Silverton. Turbines may represent a collision risk to this species if it travels over the site. A convergence of this species at the site would increase potential level of impact.	Possible

Species and Status*	Ecology	Presence of habitat	Potential for impact
Flock Bronzewing *Phaps histrionica* E	Likely to occur north of Broken Hill and west of Cobar periodically. Observed in a variety of vegetation types, including grassy plains, saltbush, spinifex and open Mulga. Preferred habitat is tussock grassland, particularly Mitchell grassland. They need to drink daily and may be seen adjacent to water, e.g. at stock tanks, bore drains and pools in water courses. Rest on the ground during the day and nest in a simple scrape on the ground in the cover of a bush, low branch, grass tussock, or in dust on bare ground around bores, often in close proximity to many others of the same species (DECC 2005p).	Known to occur in the region. However, due to the lack of open water, the site is unlikely to provide suitable habitat. It may be present closer to Umberumberka Dam.	Unlikely
Bush Stone-curlew *Burhinus grallarius* E	The Bush Stone-curlew is found throughout Australia excluding the central southern coast and inland, the far south-east corner, and Tasmania. It is rare or extinct throughout most of its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch (DECC 2005n).	Known to occur in the region with many recordings throughout the Western CMA. The site represents marginal habitat for this species.	Unlikely
Fork-tailed Swift *Apus pacificus* m	Forages over open country and nests in cliffs and tall tress. Occasional mass movements occur and this species may spend nights on the wing (Pizzey and Knight 2003).	Migrant, habitat may occur within the area. It therefore has potential to forage at turbine height as well as be susceptible to collision while migrating in groups at night.	Possible
White-throated Needle-tail *Hirundapus caudacutus* *m*	A summer migrant to Australia, this species is highflying with vertical diving displays undertaken during foraging activities. It feeds on insects. Large flocks are associated with storm fronts.	Not observed onsite. Turbines would represent a collision risk to this species if it travels over the site. Flocking behaviour increases the risk of collision.	Possible
Rainbow Bee-eater *Merops ornatus* *m*	A species of open woodlands and riverbanks. Foraging and breeding in the banks or riparian corridors could occur in the area. This species can form loose colonies when breeding.	Recorded onsite and in nearby Silverton and Umberumberka Dam site. Turbines would represent a collision risk to this species if it travels over the site.	Possible

Species and Status*	Ecology	Presence of habitat	Potential for impact
Redthroat *Pyrrholaemus brunneus* V	In NSW the species has only been recorded in Old Man Saltbush, Bluebush Maireana sp. and Nitrebush shrublands as well as Canegrass and Lignum, particularly on floodplains). This species is solitary and sedentary with no known large-scale seasonal movements (Schodde & Tidemann 1986). On the mainland, the Redthroat mainly inhabits acacia and chenopod shrublands such as those dominated by Mulga in association with chenopods or eremophilas and often along watercourses or drainage lines (Higgins and Peter 2002). Also known to occur in mallee with a diverse heath shrublayer in SA and Victoria and taller semi-arid woodlands in WA. Inhabits lignum, canegrass, spinifex, and heathlands dominated by banksia and tea tree (Victoria). In the Flinders Ranges (SA) Redthroats have been recorded in Cassinia, Daisy Bush and Hop Bush shrublands with a White Cypress Pine overstorey (Higgins and Peter 2002).	Known to occur in region, and detected during surveying. Suitable habitat within the development area includes drainage lines on plains and in shrublands. In these areas, the proposed works would include the development of access tracks, substation and control buildings. Habitat preference and the solitary and sedentary nature of this species suggests that collision impact potential is low.	Unlikely
Thick-billed Grasswren *Amytornis textiles modestus* E, v	Sedentary in dense, low saltbush, cottonbush, bluebush and nitre-bush areas on sandy plains or depressions in gibber, occurring also along watercourses in clumps of Canegrass. Seeks refuge in flood debris and in rabbit burrows. Nests near the ground within low foliage or in debris. Forages on the ground and under or around bushes for a wide variety of seeds, berries and invertebrates (DECC 2005s).	Recorded in a drainage line north (~100km) of Silverton. Suitable habitat, sandy ephemeral streams, is located in the study area. Works may affect a small area of potential habitat, should this species occur onsite.	Possible
Striated fieldwren / Rufous field wren *Calamanthus fuliginosus / Sericonis fuligniosus* V	The Rufous Fieldwren is listed as threatened under the *Calamanthus fuliginosus* listing. While the Striated Fieldwren is associated with coastal swamp heaths, the Rufous Fieldwren is known to occur in semi arid shrublands (DECC 2005ai). This species is an understorey species.	Known from the region. Suitable habitat is located in the study area. Works may affect a small area of potential habitat, should this species occur onsite.	Possible
Pied Honeyeater *Certhionyx variegates* V	Widespread throughout acacia, mallee and spinifex scrubs of arid and semi-arid Australia, movements are affected by periods of drought (DECC 2005t). Highly nomadic, following the erratic flowering of shrubs; can be locally common at times.	Known to occur in region and recorded during surveys in Mulga. It is not likely that resources important to this species would be adversely impacted. Turbines would represent a collision risk to this species if it travels over the site.	Possible
Painted Honeyeater *Grantiella picta* V	Nomadic and occurring at low densities across its range. Nests in the outer canopy of drooping eucalypts and other species. Forages on mistletoe.	Known to occur in region and recorded during surveys. It is not likely that resources important to this species would be adversely impacted. Turbines would represent a collision risk to this species if it travels over the site.	Possible

Species and Status*	**Ecology**	**Presence of habitat**	**Potential for impact**
Hooded Robin *Melanodryas cucullate* V	The species is widespread, occurring in pairs or solitary in lightly timbered country (Schodde & Tidemann 1986). It spends much of its time on the ground in woodland foraging for insects. It frequents places with dead trees and fallen timber (Schodde and Tidemann 1990). This species nests in strong bark cusps of trees.	Known to occur in region with numerous recordings within the Western CMA. However, most of these are far to the east of the study area. This species would represent a low collision risk and only a small amount of potential habitat is likely to be affected (tracks and substation).	Unlikely
MAMMALS			
Dusky hopping-mouse *Notomys fuscus* E	A deep desert specialist.	No suitable habitat occurs.	Nil
Bolam's Mouse *Pseudomys bolami* E	Inhabits semi-arid environments that contain acacia woodland with scattered low shrubs or sparse mallee communities supported by loamy to clay soils (Watts 1995). A developed chenopod understorey is important (Dickman 1993). Burrows are used as shelters.	Not known from the region.	Unlikely
Long-haired Rat *Rattus villosissimus* V	Requires densely vegetated sites but in plagues can be found in virtually all inland habitats. Eats roots, stems and leaves of grasses and herbs. Shelters during the day in complex burrow systems or in a shallow temporary burrow.	Not known from the region.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
Yellow-footed Rock-wallaby *Petrogale xanthopus* *E*	Inhabits rock outcrops in association with Mulga scrub in semi-arid environments. Eats a range of herbaceous forbs and is a competitor with exotic herbivores, particularly during droughts. Lives in colonies of up to one hundred individuals.	While the species was not observed onsite, one aged scat was found near Mount Robe. The long history and current status of super-abundant populations of introduced goat and rabbit, and the current population of foxes, the main predator of rock wallabies, makes it highly unlikely that the Yellow-footed Rock-wallaby could persist in the study area. During drought rabbits and goats would have been significant competitors for scant food and water resources. Goats would have aggressively driven rock wallabies from the refuges amongst the rocks. This is evident from the piles of goat scats every rock outcrop inspected. Foxes would have been able to predate easily on small colonies causing localized extinctions and fragmentation of the population, likely to cause a detrimental impact on any local population. It is not possible to rule out that the species could be persisting in a very small population in the study area a small number of areas supporting potential habitat (around Mt Robe and to a lesser extent Mt Franks.) As a precautionary approach, these specific areas have been mapped and will be excluded from development.	Possible
Kultarr *Antechinomys laniger* E	A terrestrial insectivore that inhabits open country, especially claypans among *Acacia* woodlands. Nocturnal, sheltering by day in hollow logs or tree-stumps, beneath saltbush and spinifex tussocks, in deep cracks in the soil and in the burrows of other animals. Widespread across arid and semi-arid NSW but present in very low numbers. Populations appear to fluctuate seasonally in response to environmental stresses, including drought and flooding (DECC 2005x).	Known to occur within the region and predicted to occur in the Barrier Ranges (DECC 2005x). Subfossilled remains confirm the presence of this species in the study area in the past. Other sightings of this species have been to the east and north-east of the study area. Suitable habitat is present within the study area.	Possible
Stripe-faced Dunnart *Sminthopsis macroura* V	Rare on the NSW Central West Slopes and North West Slopes. Preferred habitat includes native dry grasslands and low dry shrublands, often along drainage lines. During periods of hot weather cracks in the soil, grass tussocks, rocks and logs form refuge.	Known to occur in region, subfossilled bones of this species were found during the survey. A combination of drought and grazing has degraded habitat quality for this species onsite.	Possible

Species and Status*	Ecology	Presence of habitat	Potential for impact
Forrest's Mouse *Leggadina forresti* V	Preferred habitat includes arid and semi-arid plains, including tussock grassland, chenopod shrubland, Mulga and savannah woodlands, claypans and sandy ridges. Nocturnal and solitary, this animal shelters during the day in shallow burrows, cracks and possibly at the base of spinifex tussocks. They feed on seeds, insects and green leaves & stems obtaining moisture from their food (DECC 2005y).	Known to occur in the Barrier Ranges although not recorded during extensive surveying within the study area. Some areas of marginal habitat occur onsite. In these areas, works would constitute widening of existing tracks nonetheless, this species has a small home range and therefore, even works of small extent may affect this species if present.	Possible
Sandy Inland Mouse *Pseudomys hermannsbuegensis* V	Occurs in a very wide range of open vegetation types including coolibah or *Acacia* woodlands, tall open shrublands (especially Mulga scrub) and hummock grasslands. Mostly on sands (plains and dunes) and sandy loams, but also in areas of cracking earth soils and gibber plains. Refuges are burrows constructed around the base of shrubs or small trees. They congregate into large groups outside the breeding season and in groups of four to five when breeding. Seeds are the dominant food, although grass and other green plant material (including shoots), roots, small tubers and, to a lesser extent, insects are also consumed (DECC 2005z).	No records occur within the study area however it is predicted to occur within the Barrier Ranges (DECC 2005z). Extensive surveying within the wind farm development study area did not detect this species.	Possible
Long-haired Rat *Rattus villosissimus* V	The species has been recorded over vast areas in western NSW with the stronghold being north-west of NSW. The species has been known to occur in plagues originating from this region and spilling south along river channels into NSW. Otherwise, the species are found in scattered localities in low numbers. The species is threatened by the degradation of vegetation and soil structure by rabbits and livestock reduces population size and lead to local extinction.	Known to occur in region, subfossilled bones of this species were found during the survey. A combination of drought and grazing has degraded habitat quality for this species onsite	Possible
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventrus* V	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In most of Victoria, south-western NSW and adjacent South Australia, it is a rare visitor in late summer and autumn. It roosts singly or in groups of up to six, in tree hollows and buildings and in treeless areas are known to utilise mammal burrows. When foraging for insects, it flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees, and appears to defend an aerial territory (DECC 2005aa).	There are numerous records for this species in the north-east of the region. One individual was recorded during anabat surveys. Turbines may represent a collision risk to this species if it travels around and over the site.	Possible

Species and Status*	Ecology	Presence of habitat	Potential for impact
Little Pied Bat *Chalinobus picatus* V	The Little-Pied Bat is found in inland NSW (including Western Plains and slopes) in a variety of habitats including dry open forest, open woodland, Mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. It roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. It feeds on flying invertebrates and does not require free water although, in arid and semi-arid environments this colonial species may be locally common near permanent or semi-permanent water (Environment Australia 1999).	Records of this species occur to the north of Broken Hill and east of Silverton. This species was also recorded from within the wind farm study area during surveying. Suitable habitat type is present onsite, although it is degraded by a combination of drought and grazing. Umberumberka Dam may be an important resource for this and other microbats in the area. Turbines may represent a collision risk to this species. Its colonial nature increases the significance of this risk.	Possible
Eastern Long-eared Bat *Nyctophilus timoriensis* V v	In NSW this species appears to be confined to the coastal plain and nearby coastal ranges. Lowland subtropical rainforest and wet and swamp eucalypt forest, coastal rainforest and patches of coastal scrub are particularly favoured.	No records exist for this species in the area and no suitable habitat occurs within the study area. It is highly unlikely this species would be present or affected by this proposal.	Nil
Inland Forest Bat *Vespadelus baverstocki* V	Recorded from scattered localities in western NSW, but may be more widespread. Roosts in tree hollows and abandoned buildings. It has been recorded from a variety of woodland formations, including mallee, Mulga and River Red Gum. Colony size ranges from a few individuals to more than fifty. Females congregate to raise young. These bats fly rapidly and cover an extensive foraging area (DECC 2005ab).	No records exist near the study area however it is predicted to occur in the Barrier Ranges (DECC 2005ab). Turbines may represent a collision risk to this species. Its colonial nature increases the significance of this risk.	Possible
REPTILES			
Tawny Rock Dragon *Ctenophorus decresii* E	The Tawny Rock Dragon is highly specialised in its habitat requirements, being restricted to rock outcrops in ranges and gorges. The species is absent from apparently suitable habitat in other parts of its range in NSW. As such, its distribution is highly restricted and fragmented, and NSW populations may be genetically distinct from those in South Australia. This species is potentially threatened via disruption of habitat by introduced herbivores. Grazing of vegetation on and adjacent to rock outcrops by feral goats and rabbits, particularly during periods of drought.	This species was recorded at several locations during the current survey. However, weather conditions were not conducive to evaluating their highly restricted distribution across the study area. Future surveys in November/December will allow a more accurate analysis of their current status in the Stage 1b and 1c areas. Clearing required for the proposal may constitute a loss of habitat for this species.	Yes, this species will be assessed after survey during an appropriate season, the details provided in an additional report.

Species and Status*	Ecology	Presence of habitat	Potential for impact
Woma *Aspidites ramsayi* V	This terrestrial reptile occurs in north-western NSW. Its range and abundance in south-eastern Australia is considered to be undergoing serious decline. Habitat includes deserts and sandy plains, as well as dunefields and deep cracking black soil plains in semi-arid areas, hummock grasslands, shrublands or woodlands. It shelters in animal burrows, hollow logs or under grass hummocks and feeds on lizards, snakes, birds and small mammals (DECC 2005ac).	Known to occur in the region with one record north of Mount Robe. The potential habitat that would be affected by the proposed works would be marginal at best. Clearing required for the proposal may constitute a loss of habitat for this species.	Possible
Stimson's Python *Liasis stimsoni* V	This terrestrial semi-arboreal species occurs in north-west NSW, from Bourke and Gundabooka National Park in the east to Broken Hill and Wilcannia in the south, inhabiting a wide range of arid and semi-arid environments including rock outcrops, sandy plains and dunefields. In these habitats it is associated with larger trees and termite mounds. Rocky outcrops provide caves and deep crevices, tree-lined watercourses provide numerous low hollows and fallen trees. They forage nocturnally on small mammals (especially bats), birds, geckoes and other lizards, whilst juveniles take geckoes and skinks (DECC 2005ad).	Known to occur in the region with at least one record to the north of Mount Robe. Upper slope rocky outcrops that would be affected by development were searched extensively during surveys. It is possible that it occurs in the steeper gorges in lower slope landscape positions. These areas would not be affected by the proposed works.	Unlikely
Ringed Brown Snake *Pseudonaja modesta* E	A terrestrial species that inhabits drier areas including rocky outcrops and dry watercourses. Occurs in a variety of vegetation types including woodlands, shrublands, mallee and grasslands. By night it shelters in ground debris or abandoned animal burrows. It is diurnal but may forage during warm nights. Feeds predominantly on small skinks and occasionally small mammals.	This species is known to occur in region with at least one record to the west of Silverton.	Possible
Narrow-banded Burrowing Snake *Simoselaps fasciolatus* V	Inhabitats open woodland or shrubland. Shelters under well embedded fallen timber and stumps, soil cracks, litter, under grass hummocks. Grazing and fox predation are listed threats.	Known from the Barrier Range outwash, fans and plains. Onsite habitat is marginal for this species.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
White's Skink *Egernia whitii / Egernia margaretae* Endangered population	A population of skinks formally known as *E. margaretae* have recently undergone taxonomic study and have been found to be a disjunct population of *E. whitii*. The Broken Hill Complex Bioregion population has been reproductively isolated from other populations of *E. whitii* and has been listed as an endangered population.	Found only within a single gorge within Mutawintji National Park. This population is at the limit of its geographic range. Extensive searches in areas of suitable habitat did not identify this species within the study area during this study. Gerry Swan also conducted the extensive surveys across the Barrier Ranges in 1999/2000 for this species which was also not detected during that survey. Further, habitat conducive to the presence of this species (large, rocky gorges) would not be impacted by the proposal.	Unlikely
Interior Blind Snake *Ramphotyphlops endoterus* *E*	Found in red sandy soils in spinifex, Mitchell grassland or shrubland. Shelters in the ground, termite nests or under rocks and logs.	Known from the Barrier Range outwash, fans and plains. Onsite habitat is marginal for this species.	Unlikely
Crowned Gecko *Diplodactylus stenodactylus* V TSC	In NSW, known from four separate locations in the state's far west. These are Sturt National Park, Mutawintji National Park, Loch Lilly, 125km south of Broken Hill, and Thurloo Downs, 145km east of Tibooburra. Habitat preferences largely unknown. In NSW, the species has been reported from red sand habitats and elsewhere from savannah woodland and stony areas with shrubs. The species is nocturnal foraging on small insects (DECC 2005ae).	It is not likely there is suitable habitat for this species within the study area. Essentially a sand hill species.	Unlikely
Fat-tailed Gecko *Diplodactylus conspicillatus* E	In NSW, the species is known from a small number of specimens detected at three locations: Sturt National Park, Nocoleche Nature Reserve and Wanaaring Nature Reserve and a single record from Mutawintji National Park. Habitat constraints are unknown, although the species' rarity suggests that it is highly specialised in its use of habitat. The recent record collected from Sturt National Park was from riverine habitat (R.A. Sadlier, pers. comm.). It is also known to shelter in vertical spider burrows and cracks in the ground (DECC 2005af).	It is not likely there is suitable habitat for this species within the study area. Essentially a sand dwelling species. Extensive surveys on plains within the wind farm development envelope did not detect this species.	Unlikely
Wedgesnout Ctenotus *Ctenotus brooksi* V	In NSW, the species is known from few records, all from Sturt and Paroo-Darling National Park and has only been recorded from large unconsolidated sand dunes. Probably restricted to habitats containing spinifex or other clumping grassland communities. Is diurnal and feeds on a variety of small invertebrates (DECC 2005ag).	Predicted to occur in the Barrier Range and outwash areas (DECC 2005ag). There is not likely to be any suitable habitat within the study area for this species.	Unlikely

Species and Status*	Ecology	Presence of habitat	Potential for impact
Yellow-tailed Plains Slider *Lerista xanthura* V	In NSW, the species is known from two disjunct populations; one between Tarawi Nature Reserve, Ivanhoe and Broken Hill, and the other in the north-west corner of the state. It occurs in a variety of semi-arid and arid habitats; grassed alluvial sands and sand dunes, dry open woodlands and spinifex-dominated red sand plains. The species is fossorial and usually found in loose soil or sand beneath stones, logs and other surface debris. Animals are diurnal and feed on a variety of small invertebrates (DECC 2005ah).	There are no records of this species in the vicinity of the study area. It is not likely there is suitable habitat present for the species to be affected by this proposal.	Unlikely
Western Blue-tongued Lizard *Tiliqua occipitalis* V	Scattered records across central western and western NSW. Diurnally forages for insects, snails, native vegetation and carrion. Inhabits plains, swales, ranges and sometimes dunes of loamy or clayey/sandy soils vegetated by woodlands, especially mallee, shrublands (including chenopods), heaths or hummock grasslands.	While no individuals were recorded during the study, Spinifex habitat is present, which constitutes suitable habitat for this species.	Possible
Marble-headed Snake-lizard *Delma australis* E	Preferred habitat is known to be spinifex on sand. The closest record is from Coombah, 150km south of the site.	Recorded in spinifex on rocky ridges during the wind farm development envelope assessment. Development may constitute a loss of habitat for this highly restricted species.	Possible
Slender Mallee Blue-tongue Lizard *Cyclodomophus melanops* E	Preferred habitat is spinifex grassland. The closest record to the site is from Coombah, 150km south of the site.	Recorded in several locations in spinifex within rocky areas within the wind farm development envelope. Development may constitute a loss of habitat for this highly restricted species.	Possible
FISH			
Silver Perch *Bidyanus bidyanus* V	The most abundant remaining natural population occurs in the central Murray River downstream of Yarrawonga Weir as well as several of its anabranches and tributaries.	Known to occur in region. No suitable habitat would be affected by the proposal.	Nil
Murray Cod *Maccullochella peelii peelii* v	Occurs naturally in the waterways of the Murray-Darling Basin and is known to live in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs.	There is no suitable habitat present within the study area for this species.	Nil
MOLLUSCS			

Species and Status*	Ecology	Presence of habitat	Potential for impact
River Snail *Notopala sublineata* E	Virtually extinct throughout its natural range. Populations have been recorded as surviving in artificial habitats (irrigation pipelines) in the Murray and Darling systems. Historic habitat is flowing rivers throughout the Murray-Darling system, attached to logs and rocks or crawling in the mud.	Known to occur in region. No suitable habitat would be affected by the proposal.	Nil

V Listed as Vulnerable on the *NSW Threatened Species Conservation Act, 1995*

E Listed as Endangered on the *NSW Threatened Species Conservation Act, 1995*

v Listed as Vulnerable on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

e Listed as Endangered on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

m Listed as Migratory on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

APPENDIX D: ASSESSMENT OF SIGNIFICANCE

D.1 NSW listed species

The following Assessment of Significance has been completed in accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*. Section 94 of the *TSC Act* lists seven factors ('7 part test') that need to be considered prior to determining if the proposed activity is likely to have a significant effect on the threatened species, populations or ecological communities, or their habitats.

This Act is not applicable for Part 3A Major Projects however, the 7-part test is considered by the authors of this report to provide the most appropriate and transparent characterisation of potential impact.

The following NSW listed threatened species were assessed to have potential for impact as a consequence of site development. They were assigned the impact rating in Appendix C of:

'Possible *Suitable habitat is present and would be affected by the proposal'*

No Endangered Ecological Communities listed under the *TSC Act* were identified as having the potential to be adversely affected by the proposed works.

Flora	
Showy Indigo E	Yellow-keeled Swainsona E
Creeping Darling Pea E	
Birds	
Thick-billed Grasswren E, v	Rufous Fieldwren V
Pink Cockatoo V	Scarlet-chested Parrot V
Painted Honeyeater V	Pied Honeyeater V
Barking Owl V	Masked Owl V
Grey Falcon V	Black-breasted Buzzard V
Australian Bustard E	Square-tailed Kite V
Mammals	
Inland Forest Bat V	Yellow-bellied Sheathtail-bat V
Little Pied Bat V	Stripe-faced Dunnart V
Kultarr E	Forrest's Mouse V
Sandy Inland Mouse V	Yellow-footed Rock-Wallaby E, v
Long-haired Rat V	
Reptiles	
Tawny Rock Dragon* E	Slender Mallee Blue-tongue Lizard E
Ringed Brown Snake E	Marble-headed Snake-lizard E
Woma V	Western Blue-tongue lizard V

V Listed as Vulnerable on the *NSW Threatened Species Conservation Act, 1995*
E Listed as Endangered on the *NSW Threatened Species Conservation Act, 1995*
v Listed as Vulnerable on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*
e Listed as Endangered on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*
m Listed as Migratory on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

*It should be noted that an assessment of significance has not been undertaken for the Tawny Rock Dragon (*Ctenophorus decressi*). Surveys for this species must be undertaken in warmer months conducive to adequately detecting their presence. Our findings from the Stage 1a Biodiversity Assessment revealed that the species was absent from apparently suitable habitat. As such, the only way of detecting this species is by physical presence, which will be undertaken when males are most actively displaying by perching on exposed rocks during November/December (further surveying for this species has been included as a recommendation of this report).

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Flora

Showy Indigo

Showy Indigo is known to grow on rocky hills and along creek beds in limited numbers. Presently it is known to occur in the Waukeroo Hills (east of the study area) and in the Musgrave and Flinders Ranges in W.A. The Bionet mapping tool shows scattered records across the Broken Hill Complex bioregion. This species is generally known to occur only in small cohorts.

Disturbance has been recognised as a threat to this species, contributing to a lack of regeneration and reduced genetic diversity; hence, viable populations are not expected to occur along existing tracks or in other disturbed areas onsite. The combined effects of drought and grazing have reduced the quality of the site such that the majority of areas that constitute potential habitat for this species could be considered poor to marginal.

The development of the wind farm would include excavation for tracks and other infrastructure, as well as upgrading existing roads, in areas of potential habitat. If present, individuals of this species would be lost. Given the quality of potential habitat present and the pattern of works (the location and amount of area that would be disturbed - narrow tracks and discrete development areas) the chances of affecting a viable population of this species such that the population is no longer viable is low.

Yellow-keeled Swainsona

This species is known from deep red sand, recorded from a roadside on a treeless plain, as well as Mulga communities and along creeklines (in central Australia), both of these latter habitat types are present onsite. Specific to the region, habitat preference is noted as arid shrublands and freshwater wetlands. It is not common in NSW and is known from the Barrier Ranges.

Threats to this species include grazing (it is palatable to stock), clearing of Mulga communities, erosion, feral animal disturbance and seed viability in the soil seedbank (DECC 2005g). Similar to the Showy Indigo, discussed above, the combined effects of drought and grazing have reduced the quality of the site such that the majority of areas that constitute potential habitat for this species could be considered poor to marginal. Also, given the quality of potential habitat present and the pattern of works, the chances of affecting a viable population of this species such that the population is no longer viable is low.

Creeping Darling Pea

This species grows in dry, sandy or stony areas on the banks or within creeks. It has been recorded in the Broken Hill area on sandy soils near watercourses and is also known from a roadside sandplain in sandy-loam soil (DECC 2005i). Populations have been recorded as being “large and plentiful” but also infrequent (DECC 2005i). It is generally regarded as a short-lived plant, which makes it particularly susceptible to the impacts of grazing, in particular, feral goats which are suggested to prefer younger plants.

This species was not detected in the study area or the wider area to the south after extensive searches in apparently suitable habitat (along creeklines). In the case of this species, grazing could influence the viability of the seedbank, which may explain their apparent absence.

As discussed for the preceding species, the development of the wind farm would include excavation for tracks and other infrastructure, as well as upgrading existing roads, in areas of potential habitat. If present, individuals of this species would be lost. The disturbance to creek lines would be limited, restricted to track installation and upgrades, hence the pattern of works suggests the chances of affecting a viable population of this species such that the population is no longer viable is low.

Birds

Thick-billed Grasswren, Rufous Fieldwren

The Thick-billed Grasswren, known from the area, is a sedentary species, associated with dense, low saltbush, cottonbush, bluebush and nitre-bush on sandy plains or depressions in gibber, occurring also along watercourses in clumps of Canegrass. Flood debris and rabbit burrows represent suitable refuges. Nests are constructed low to the ground within low foliage or in debris. It is a ground forager, which seeks out a wide variety of seeds, berries and invertebrates (DECC 2005s). The Rufous Fieldwren is similarly an understorey species in arid and semi-arid shrublands and is known from the region.

Works may affect a small area of potential habitat for these species, should they occur onsite. This would be related to clearing for the installation of tracks and infrastructure (substation, control buildings, stock pile areas, concrete batching, etc. as detailed in point **d)** of this 7-part test).Their sedentary nature and habitat preference for low growing vegetation and debris places them at very low turbine collision risk / avoidance behaviour. It is highly unlikely that the amount and location of clearing proposed would adversely affect these species or generate a life cycle impact sufficient to threaten a viable local population.

Pink Cockatoo, Scarlet-chested Parrot, Painted Honeyeater, Pied Honeyeater

The Pink Cockatoo was recorded in the 2007 surveys. It is found regularly in a wide range of treed and treeless inland habitats, always within easy reach of water. Nesting, in tree hollows, occurs with no more than one pair every 30 square kilometres (DECC 2005o). The restriction of this resource to large drainage lines and its requirement for permanent water indicates this species would be concentrated at the south-west of the site, near Umberumberka Dam. While it feeds mostly on the ground on the seeds, it is known to flock in small to large groups where food is abundant. It was observed flying within the turbine collision zone in areas where turbines are proposed.

The Scarlet-chested Parrot is known from the area. It inhabits arid to semi-arid areas, foraging on or near the ground, usually nesting close to the ground within small trees. Populations can be large during years of abundant rainfall. Several pairs may nest within neighbouring trees. One record occurs south of Silverton. Turbines may represent a collision risk to this species if it travels over the site. A convergence of this species at the site would increase the potential level of impact.

The Pied and Painted Honeyeaters are nomadic, following the erratic flowering of shrubs. The former can be locally common at times but neither species is known to flock or occur in large congregations. Important resources include nectar and mistletoe, saltbush fruit, berries, seed, flowers and insects. They are both known from the local area, associated with the shrublands.

For these species, it can be seen that foraging resources would be only minimally affected, and considering the pattern of works, loss of habitat and modification of habitat is similarly considered to pose a low risk to the lifecycle of these species, such that a viable population may be placed at risk. For the Pink Cockatoo and Scarlet-chested Parrot however, collision risks exist. Sustained mortalities due to collisions could, potentially, constitute a threat to the viability of a local population. This would require ongoing collisions to occur over a lengthy period of time to the extent the local population was reduced to a nonviable level. As such, it is considered unlikely that these species would be placed at risk of extinction.

Grey Falcon, Masked Owl, Barking Owl, Black-breasted Buzzard, Australian Bustard, Square-tailed Kite

The Grey Falcon is known from the region. It inhabits open woodland but is usually restricted to shrubland, grassland, wooded watercourses and wetlands where surface water attracts prey. Nests are usually located high in a living eucalypt near water or a watercourse. Habitat and foraging resources in the study area are suitable for this species. It predates primarily on birds, especially parrots and pigeons, using high-speed chases and stoops.

The Masked and Barking Owls have similar habitat requirements. They forage in a range of forest and woodland types, preferring dense vegetation for roosting and large tree hollows for nesting. For the Masked Owl, forested areas adjacent to areas of dense and sparse ground cover within close proximity are required for foraging (Garnett 1993 & Peake *et al.* 1993). Potential nesting and foraging habitat occurs within the study area. Roosting habitat is less abundant and would be expected to be associated with the more dense tree concentrations near drainage lines.

The Black-breasted Buzzard and Australian Bustard are associated with a range of inland habitats, where they hunt over grasslands and sparsely timbered woodlands. The former requires timbered watercourses as breeding habitat while the latter breed in more open areas. While foraging habitat occurs within the development envelope, foraging is unlikely to place these species within the turbine collision zone. Longer distance movements for the Black-breasted Buzzard occurring over the site may however place individuals at risk.

In arid north-western NSW, the Square-tailed Kite, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland (DECC 2005k). It is also known from timbered river courses. It forages in the outer canopy on nestlings and insects and is therefore more likely to be associated with the more dense concentrations of Mulga and the drainage lines onsite.

For these six species, foraging resources and nesting resources are unlikely to be affected by the proposal to the extent that a life cycle impact would result for an individual of any species. Collision risk is present however for all of these species. For species foraging within the potential collision zone, the risk may result in ongoing mortalities such that a local population is affected. This includes the Grey Falcon and potentially the Masked Owl, Barking Owl and Square-tailed Kite, although all three species are more likely to be associated with more dense concentrations of trees in the lower landscape positions and not on the ridges where turbines would be located. A risk is present to all five species when they move across the site, in longer-distance movements (ie dispersing or migrating).

These species occur at low densities within the landscape and ongoing mortalities would be required to constitute a local population scale impact. The significance of mortalities to the local population would depend on other factors, such as the importance of onsite and offsite habitat. For example, if the site harbours a source population, from which individuals regularly disperse to surrounding more marginal areas, the significance of mortalities (and therefore the risk of a local population impact) would be greater. For the Grey Falcon, Masked Owl, Barking Owl, Black-breasted Buzzard and Square-tailed Kite, this may be the case, as the ridge system and associated drainage lines of the Barrier Ranges provide resources which are rare on the surrounding plains (woodland and timbered water courses). If these species are present on site, monitoring of collision impacts would be required to address the risk of a population level impact occurring.

Mammals

Inland Forest Bat, Yellow-bellied Sheathtail-bat, Little Pied Bat

The Inland Forest Bat has been recorded from a variety of woodland formations, including mallee, Mulga and River Red Gum. It roosts in tree hollows and abandoned buildings with colony size ranging from a few individuals to more than fifty. Females congregate to raise young. These bats fly rapidly and cover an extensive foraging area (DECC 2005ab).

The Yellow-bellied Sheathtail-bat was recorded once as one anabat file. This species roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, it flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across a very wide range.

The Little-Pied Bat was identified from anabat recording in the 2007 surveys at Umberumberka Dam but not recorded in the Stage 1b or 1c areas. It occurs in a variety of habitats that are present including open woodland, Mulga woodlands and chenopod shrublands. It feeds on moths and this colonial species roosts in caves, rock outcrops, mine shafts, tunnels, tree

hollows and buildings. In arid and semi-arid environments this colonial species may be locally common near permanent or semi-permanent water (Environment Australia 1999) which may explain the absence of this species away from Umberumberka Dam.

For all three species, it can be seen that foraging resources would be only minimally affected, with foraging more likely located outside of the potential turbine collision zone, in areas containing more dense concentrations of trees and around water sources. However, all three species are known to be colonial and have fast flying and wide ranging movements. This suggests primarily that the density of the species onsite and therefore the risk that collisions with turbines would occur would be greater than for solitary, sparsely distributed species. Secondly, wide ranging and fast flying species may be considered at greater risk of collision that more sedentary species. A third factor is the proximity of roosts. Species roosting in tree hollows are likely to be outside of the collision zone, as most hollows and refuge are located in the lower slope positions. Only the latter species, the Little-Pied Bat, may seek refuge within rocky outcrops close to potential turbine sites and therefore could be at increased risk of collision. However, its association with water sources may limit the distribution of this species to only the southern end of the study area. Collisions sufficient to place a local population at risk of extinction are a risk for all three species. The risk is considered low to moderate for the Inland Forest Bat and Yellow-bellied Sheathtail-bat but potentially greater for the Little-Pied Bat.

Stripe-faced Dunnart, Kultarr, Forrest's Mouse, Long-haired Rat, Sandy Inland Mouse

The Stripe-faced Dunnart inhabits native dry grasslands and low dry shrublands, often along drainage lines and seeks refuge in the soil, in grass tussocks and under rocks and logs.

The Kultarr inhabits open country, especially claypans among Acacia woodlands, sheltering by day in hollow logs or tree-stumps, beneath saltbush and Spinifex tussocks, in deep cracks in the soil and in the burrows of other animals. While it is generally at low density, populations appear to fluctuate seasonally in response to environmental stresses, including drought and flooding (DECC 2005x).

The Forrest's Mouse inhabits arid and semi-arid plains, including tussock grassland, chenopod shrubland, Mulga and savannah woodlands, claypans and sandy ridges, sheltering during the day in shallow burrows, cracks and possibly at the base of Spinifex tussocks (DECC 2005y). This species has a small home range.

The Long-haired Rat occurs primarily in the north-west of the state, and are generally confined to mesic, densely vegetated sites. However, during plagues, the species can be found in virtually all inland habitats.

The Sandy Inland Mouse inhabits a very wide range of open vegetation types including coolibah or Acacia woodlands, tall open shrublands (especially Mulga scrub) and hummock grasslands. Mostly on sands (plains and dunes) and sandy loams, but also in areas of cracking earth soils and gibber plains. Refuges are burrows constructed around the base of shrubs or small trees. They congregate into large groups outside the breeding season and in groups of four to five when breeding.

All but the Sandy Inland Mouse are known from the region. Suitable habitat for all four species is present onsite, but largely degraded by feral goat populations and are predominantly in the lower landscape positions where infrastructure such as tracks, substation, control buildings, stock pile areas, concrete batching, etc. (detailed in point **d)**) would be located. These areas appear in general to be quite degraded, being heavily grazed over most of the site. The nearby Day Dream Mine access provides better quality habitat, having a greater density of ground cover and shrub vegetation. Spinifex covered ridges onsite may also provide good habitat. Cracking soils preferred for sheltering are not present and ground refuge is sparse. It has been noted previously in this report that no small mammal species were captured in Elliot, funnel or pitfall traps or were recorded incidentally and that the study area provides poor refuge and connectivity for small mammals. If present, they are likely to be in very low density. Loss of habitat and direct mortalities through crushing of burrows could potentially generate lifecycle impacts to these species if present. However, given the quality of habitat and the pattern and

extent of the proposed works, the potential for local population level impacts is considered remote.

Yellow-footed Rock Wallaby

The Yellow-footed Rock-wallaby (*Petrogale xanthopus*) inhabits semi-arid country, occurring on rock outcrops in association with Mulga scrub. The species was formerly more widespread through the ranges of South Australia, western NSW and into south-western Queensland and was thought to have occurred over the entire north-western NSW fold belt from Broken Hill to Tibooburra, including the Barrier Ranges. In NSW, the species is now only known to occur within Mutawintji National Park and Mutawintji Nature Reserve, where less than 100 animals were counted in the 2003 surveys. The cliffs, rocky slopes and rockfalls on and adjacent to the Gap and Coturaundee Ranges (to the north of the study area) are significant habitat for the Yellow-footed Rock-wallaby.

Evidence of the historic existence of Yellow-footed Rock Wallaby was found near Mt Robe by aged scats. The Barrier Ranges is within the historic range of *P. xanthopus* and from our observations it appears that there is limited potential habitat to be found within the area of the windfarm development.

At one site, south-west of Mt Robe, a rocky complex of boulders, exposed faces and ledges revealed aged scats that were possibly Petrogale. In addition and probably more significant were observations of “shiny rock” which is a feature of such habitat that is occupied by rock wallabies. After extensive searches, no fresh faecal material was located but deep within the crevices and under the cave floor debris there were old scats that appeared to be Petrogale.

Past discussions with the lesees of Purnamoota Station reveal the historial presence of Yellow-footed Rock Wallaby at Mt Robe, and some old records are also shown in the NSW Atlas of Wildlife Database.

The long history and current population of super-abundant populations of introduced goat and rabbit, and the current population of foxes, the main predator of rock wallabies, makes it highly unlikely that the Yellow-footed Rock-wallaby could have persisted in this area.

During drought goats, and to a lesser extent rabbits, would have been significant competitors for scant food and water resources. Further, the dietary overlap between goats and this species is known to increase markedly during drought, making it even more difficult for rock wallabies to survive these conditions (DECC 2008). Goat numbers, if left unchecked, will suppress rock-wallaby numbers immediately after a drought and may delay their recovery to pre-drought levels for several years (DECC 2008).

Goats would have aggressively driven rock wallabies from the refuges amongst the rocks. In fact, goats have been observed to physically expel colonies of up to a dozen Yellow-footed Rock-wallabies from their shelters (DECC 2008). This is evident from the piles of goat scats every rock outcrop inspected. Foxes would have been able to pick off small colonies causing localized extinctions and fragmentation of the population, likely to cause a detrimental impact on any local population.

This study has identified a number of significant rock outcrops, that could potentially provide habitat for the species. While it is considered that is it extremely unlikely that this species still exists within the Barrier Ranges due to the presence of introduced herbivores (goats and rabbits) and predation by foxes, Rock wallabies across Australia have had an uncanny ability to survive in very tiny remnant populations for many years, often undiscovered. Therefore, the adoption of a precautionary approach is wise.

An intensive feral goat control program should be initiated in the study area. These feral animals are key threats to this species (and most forms of biodiversity) and are recognised as key threatening processes under the NSW *Threatened Species Conservation Act 1995*. If any individuals of the Yellow-footed rock wallaby occur in the study area, their mere existence and long-term survival is only predicted with these control programs in place. This would indicate

that the construction of the wind farm with its associated goat management program will have a net a positive impact for this species should it be present.

Reptiles

Ringed Brown Snake

The Ringed Brown Snake inhabits rocky outcrops and dry watercourses in a variety of vegetation types including woodlands, shrublands, mallee and grasslands, such as occur onsite. Ground debris or abandoned animal burrows form nocturnal shelters. It feeds predominantly on small skinks and occasionally small mammals, the former being abundant onsite. It was not detected during extensive surveying onsite in rock outcrops and in dry watercourses. If turbines, roads or hardstand areas were placed within rock outcrops, it may constitute a loss of habitat. Dry watercourses would be minimally affected and any protection of habitat for the Tawny Rock Dragon, would also benefit this species, if present, avoiding the potential for a life cycle impact and subsequent decline of a viable local population.

Slender Mallee Blue-tongue Lizard, Western Blue tongue, Marble-headed Snake-lizard, Woma

For the Slender Mallee Blue-tongue Lizard, Marble-headed Snake-lizard and Western Blue tongue lizard, preferred habitat is known to be Spinifex on sand. The two former species were recorded in Spinifex on rocky ridges during the 2007 and 2008 surveys. This is considered unusual for these species as no Spinifex on sand is present within the development envelope.

Differing from the Stage 1a survey areas, most plants showed evidence of seeding this year, suggesting the Spinifex is in excellent condition. While it appears unusual to find these species on rocky ridges and slopes instead of sand, the Spinifex on rocky ridges appears to be a critical resource for the local populations of these species in the area, and it is regarded as a regionally significant habitat type. Spinifex grassland is notoriously difficult to regenerate, hence preserving areas where it occurs onsite, is considered important to protecting these species onsite in the long-term.

The Woma occurs in deserts and sandy plains, as well as dunefields and deep cracking black soil plains in semi-arid areas, hummock grasslands, shrublands or woodlands. It shelters in animal burrows, hollow logs or under grass hummocks (DECC 2005ac). Although not recorded onsite, it is known from the Barrier Ranges. The potential habitat that would be affected by the proposed works would be marginal at best however, development may constitute a loss of habitat for this species and therefore may have an effect on the size of a local population and constitute a threat to local population viability.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No endangered populations are known from the site.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

No endangered ecological communities are known from the site.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Table 4 provides an estimate of the type and quantum of native vegetation loss required for the development of Stage 1b and 1c of the wind farm not assessed in the initial biodiversity assessment (illustrated on Map 7). Based on these calculations, these works would displace approximately 132 hectares of native vegetation. Approximately 11 hectares of native vegetation would be disturbed to enable the construction of the turbines; this could be rehabilitated after the construction phase. An additional 97 hectares could be rehabilitated after the life of the project. Approximately 24 hectares of native vegetation would be permanently displaced (footings would remain insitu after the project is decommissioned).

The works envelope includes some areas with prior disturbance including many existing tracks that would be upgraded to accommodate vehicles access and turning circles. As well, most areas show extensive degradation from a combination of drought and feral goat grazing; large areas of bare soil, vegetation pruned by grazing and accumulations of goat scat attest to this.

There is the potential to positively address the impact of goats on site biota by instituting a management program to more intensively harvest goats. Implemented as part of the proposal, this would provide a significant benefit to the biodiversity of the study area, and in offsetting any direct impacts of the proposal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

For the flora and fauna considered in this assessment, the proposed infrastructure is not anticipated to represent a fragmentation of potential habitat.

For birds, while the turbines do not represent an absolute barrier (they do not dissect the range system, but occupy a large area on the western edge of the system), avoidance behaviour may result in some fragmentation of currently available habitat onsite. This effect is likely to be negligible for most of the birds considered as they are wide ranging species (Pink Cockatoo, Scarlet-chested Parrot, Painted and Pied Honeyeater, Grey Falcon, Black-breasted Buzzard, Australian Bustard, Square-tailed Kite, Barking and Masked Owl). For the smaller-ranging species, it could be speculated that the presence of turbines on ridgetops may hinder dispersal across the range. The applicable species in this case however, the Thick-billed Grasswren and Rufous Fieldwren, inhabit and disperse across low lying plains, as opposed to ridge systems, and so would be unlikely to be affected by the turbines.

For reptiles, the development of tracks may dissect areas of habitat and create a barrier to dispersal. Mapping key habitat areas and minimising tracks or rehabilitating tracks in these areas is recommended.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Generally, given the extent and pattern of works proposed, the condition of habitat and representativeness of this habitat, it is not considered that the works would not alter or remove an important area of habitat. There are two exceptions to this statement.

The Spinifex grasslands harbouring the Marble-headed Snake-lizard and Slender Mallee Blue-tongue Lizard and potentially the Western Blue tongue lizard is regarded as regionally significant habitat. The occurrence of the Marble-headed Snake-lizard and Slender Mallee Blue-tongue Lizard in Spinifex on ridges is unusual, these species being more usually associated with Spinifex on sands (of which none is present onsite).

Secondly, the Barrier Range ridge system, of which the development would occupy a large area of the western edge, provides resources that are generally absent on the surrounding

plains. These include timbered watercourses and areas of dense woodland, and mature hollow-bearing trees able to provide refuge for medium to large fauna. These resources would be considered important for wide ranging raptors including the Grey Falcon, Masked Owl, Barking Owl, Black-breasted Buzzard and Square-tailed Kite, should they occur onsite. The surrounding ridges to the north, east and south are assumed to also contain these resources, however, at the scale of a breeding pair, the habitat within the development envelope could be considered important. Monitoring will be required to establish actual impacts.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

There is no critical habitat as listed by the *TSC Act 1995*, found within the subject site.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Five Recovery Plans and one Threat Abatement Plan are relevant to this assessment.

A Recovery Plan has been prepared for the Forrest's Mouse. Relevant threats to this species are noted to include fox predation (known to be present onsite although currently in low numbers) and grazing (feral goat grazing is heavy in many areas onsite). Features which make this species susceptible to decline include the reliance on burrowing, use of shrubland habitat, small body weight and omnivorous diet. Relevant recovery actions for this species relate to monitoring existing populations, surveying for new populations and maintaining and reviewing feral animal management programs. The proposed works are not inconsistent with any of these actions.

A Recovery Plan has been prepared for the Kultarr. Habitat degradation through overgrazing, predation by feral cats and foxes, severe local flooding, fire, as well as insecticide and pesticide use are listed threats to this species, linked to its decline. Recovery objectives relate to increasing what is known of habitat requirements, threats and distribution and increasing community awareness.

A Recovery Plan has been prepared for the Thick-billed Grasswren. The decline of this species is thought to be associated with the degradation of understorey vegetation caused by over stocking, goat and rabbits herbivory. Introduced predators, including feral cats, are also considered a threat to this species and are responsible for a number of local extinctions. Relevant recovery objectives for this species relate to surveying in areas likely to contain extant populations, establishing community awareness and monitoring the results of future fauna surveys. The proposed works are not inconsistent with any of these actions.

A Recovery Plan has been prepared for the Barking Owl and for Large Forests Owls (incorporating the Masked Owl). Habitat loss, degradation and fragmentation are major threats to forest owls. Wildfires, grazing, pest control, drought and predation are also listed.

A common theme for the species considered is the combined effects of drought and overgrazing on habitat resources. There area likely to be benefits for multiple species in controlling heavy grazing by feral goats onsite.

A Threat Abatement Plan has been prepared for the Red fox. This species is known to occur onsite. While tracks can often be seen to facilitate the movement of this species, the existing openness of the site could already be considered to allow unrestricted access of this species over the site. The proposed works would not benefit this species or be in contravention of the aims of this plan.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Several listed Key Threatening Processes (KTPs) are relevant to the proposal: bushrock removal, clearing of native vegetation, competition and grazing by the feral European rabbit, competition and habitat degradation by feral goats, predation by the red fox, human-caused climate change and removal of dead wood and dead trees.

Bushrock removal can remove or disturb the habitat of many native species, which may find shelter in or under rocks, use rocks for basking, or which grow in rocky areas (NSW Scientific Committee 1999). Many species listed as threatened in NSW, including the Tawny Rock Dragon and Ringed Brown Snake, are reliant on the habitat that bush rock provides. The creation of roads and hardstand areas may redistribute but would not remove rocks from the site.

Clearing of native vegetation constitutes destruction of flora and fauna habitat and is the major cause of loss of biological diversity (NSW Scientific Committee 2001). For species of restricted distribution, clearing of native vegetation may result in total extinction, for more widespread species there may be loss of local genotypes (NSW Scientific Committee 2001). The proposed works would result in approximately 83 hectares of native vegetation loss. Most of the tracks would be developed over existing tracks. Further more, the area is sparsely vegetated. Combined heavy goat grazing and drought are likely to have been responsible for extensive die back of a large proportion of all vegetation strata onsite; trees, shrubs and ground cover. As stated in point **d)** of this assessment, important habitats occur onsite (including rocky outcrops and spinifex areas) and are considered important resources to retain.

Competition and grazing by the feral European rabbit and Competition and habitat degradation by feral goats are both listed as Key Threatening Processes. Both species are present onsite and evidence of the degradation caused by these species includes warrens (rabbits only), heavy grazing (both species) and associated erosion and die back. Landforms are steep and unstable in places and vegetation to bind soils is sparse. The proposed works may exacerbate the associated erosion onsite. Erosion and sediment controls will be required to address this impact. Control of goat numbers onsite however, if implemented as part of this proposal, would have substantial benefits.

Predation by the red fox has been implicated in limiting habitat choice and population size of a number of medium-sized marsupials. Even at low densities foxes can eliminate remnant populations and instigate localised declines. Foxes are also one of several factors which have been implicated in the disappearance of many medium-sized, ground-dwelling mammals from the arid and semi-arid regions of New South Wales. As discussed, this species is known to occur onsite. While tracks can often be seen to facilitate the movement of this species, the existing openness of the site could already be considered to allow unrestricted access of this species over the site.

Human-caused climate change is recognised as likely to generate a different response from organisms than the climate change that has occurred through geologic history. Modelling suggests that many species will be adversely affected including those with long generations, poor mobility, narrow ranges, specific host relationships, isolate and specialised species and those with large home ranges (Hughes and Westoby 1994). Pest species may also be advantaged by climate change. The proposal to develop a wind farm would not have immediate or local effects in this regard, it constitutes a significant part of NSW's strategy to address climate change.

The accelerated and ongoing Removal of standing dead trees and woody debris on the ground caused by human activity has been recognised as a factor contributing to loss of biological diversity (ANZECC 2001). Removal of dead wood and dead trees can cause the broad scale change of woodlands into paddocks with isolated standing trees, with little natural understorey and no woody debris on the ground (Landsberg 2000). The proposed works would result in

minimal clearing given the sparsity of native vegetation in many areas. Combined heavy goat grazing and drought are likely to have been responsible for extensive die back of all vegetation strata in many areas onsite; including trees, shrubs and ground cover. Where trees, standing dead trees and woody debris must be moved to allow for the tracks and hardstand areas, it is recommended that it be placed adjacent to the impact areas, to retain this refugia in the immediate area.

D.2 Commonwealth listed species

The *Environmental Protection and Biodiversity Conservation Act* 1999 specifies factors to be taken into account in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level.

The following Commonwealth listed threatened species were assessed to have potential for impact as a consequence of site development. They were assigned the impact rating in Appendix C of:

'Possible *Suitable habitat is present and would be affected by the proposal'*

No Endangered Ecological Communities listed under the *EPBC Act* were identified as having the potential to be adversely affected by the proposed works.

Birds:

Thick-billed Grasswren E, v

Rainbow Bee-eater m

Fork-tailed Swift m

White-throated Needle-tail m

Mammals

Yellow-footed Rock Wallaby E, v

E Listed as Endangered on the *NSW Threatened Species Conservation Act, 1995*

v Listed as Vulnerable on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

m Listed as Migratory on the Commonwealth *Environmental Protection Biodiversity Conservation Act, 1999*

D2.1 Vulnerable species

Thick-billed Grasswren,

This assessment relies on information already stated in Section D.1 of this report, to avoid duplication of information.

a) Will the action lead to a long-term decrease in the size of a population of a species?

Their sedentary nature and habitat preference for low growing vegetation and debris places them at very low turbine collision risk / avoidance behaviour. It is highly unlikely that the amount and location of clearing proposed would lead to a long-term decrease in the size of a local population.

b) Will the action reduce the area of occupancy of the species?

Works may affect a small area of potential habitat for this species, should the species occur onsite. This would be related to clearing for the installation of tracks and infrastructure. Refer to *Table 4-2 Estimated extent of vegetation loss.*

c) Will the action fragment an existing population into two or more populations?

It could be speculated that the presence of turbines on ridgetops may hinder dispersal of this species across the range, effectively constituting a fragmentation of available habitat. However, this species inhabits and disperses across low lying plains, as opposed to ridge systems, and so would be unlikely to be affected by the turbines.

d) Will the action adversely affect habitat critical to the survival of a species?

Critical habitat for this species is assumed to consist of dense, low saltbush, cottonbush, bluebush and nitre-bush on sandy plains or depressions and watercourses. The impact in this

habitat would largely be confined to the upgrade of access tracks as well as the development of the substation, stockpile areas and control rooms. The areas of impact proposed and local distribution of habitat resources suggest this effect would not be significant.

e) Will the action disrupt the breeding cycle of a population?

The works proposed would be unlikely to disrupt a breeding population, should one occur within the works envelope. Fox predation and grazing by goats represent a larger threat to this species. These effects would not be exacerbated by the proposal.

f) Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

As discussed, the areas of impact proposed and local distribution of habitat resources suggest this effect would not be significant.

g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered or critically endangered species/vulnerable habitat?

It is expected that an Construction Environmental Management Plan would specify weed controls (and soil conservation measures) to be employed during construction, hence the site would not be substantially modified with respect to potential habitat for these species.

h) Will the action interfere with the recovery of the species?

A NSW Recovery Plan has been prepared for this species. Relevant recovery objectives for this species relate to surveying in areas likely to contain extant populations, establishing community awareness and monitoring the results of future fauna surveys. The proposed works are not inconsistent with any of these actions and considering the threats posed by the proposal to habitat, this effect is not anticipated.

<u>Yellow-footed Rock Wallaby</u>

This assessment relies on information already stated in Section D.1 of this report, to avoid duplication of information.

a) Will the action lead to a long-term decrease in the size of a population of a species?

No. The presence of an aged scat confirms the past presence of this species in the study area. During the surveys, no sightings of animals, or other signs of their presence have been recorded. While it is unlikely that the species has persisted through drought and competition with the large goat population that is currently present, the actual development has a generally small footprint in comparison with the entire study area. A goat management plan with the objective of decreasing goat numbers currently present, would be a significant benefit to this species, should it persisting in very small numbers on the site. As such, it is highly unlikely that the proposal would lead to a long-term decrease in the size of a local population.

b) Will the action reduce the area of occupancy of the species?

No. The proposed Windfarm occupies a very small proportion of the larger study area which will be under the auspices of a Goat Management Plan with the objective to reduce high goat abundance currently present, a recognised threat as a competitor for habitat and resources of this species. As such, the proposal has the potential to increase the area of potential habitat and area of occupancy, should it be present in the study area.

c) Will the action fragment an existing population into two or more populations?

It could be speculated that the presence of turbines on ridgetops may hinder dispersal of this species across the range, effectively constituting a fragmentation of available habitat. However, this species is not shy of human activity, being easy to approach in similar rocky ranges such as the Flinders Ranges in SA. The current and historical goat and fox populations are likely to

be contributing to any habitat fragmentation *per se*, should this species still persist in the study area.

d) Will the action adversely affect habitat critical to the survival of a species?

Whilst no Critical Habitat in terms of the TSC Act has been defined for this species, significant rocky outcrops that are free of goat and fox populations are considered crucial to the long-term survival of this species. No rock outcrops are present that do not show signs of goat residence. The implementation of a Goat Management Plan with the objective of reducing high goat abundance as is currently present, is likely to restore areas of suitable habitat. As such, the proposal has the potential to increase the area of potential habitat for this species, a positive benefit, should it still persist in the study area.

e) Will the action disrupt the breeding cycle of a population?

The works proposed would be unlikely to disrupt a breeding population, should one occur within the works envelope. Fox predation and grazing by goats represent a larger threat to this species. These effects would not be exacerbated by the proposal, but rather, actively managed as a result of the proposed development.

f) Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

As discussed previously, the proposal would not impact on potential habitat for this species, but rather seek to maintain and improve these resources should a population persist in the study area.

g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered or critically endangered species/vulnerable habitat?

It is expected that a Construction Environmental Management Plan would specify weed controls (and soil conservation measures) to be employed during construction. Therefore, the site would not be substantially modified with respect to potential habitat for these species.

h) Will the action interfere with the recovery of the species?

No. The protection of significant rocky outcrops and the recovery objectives for this species relate to surveying in areas likely to contain extant populations, establishing community awareness and monitoring the results of future fauna surveys. The proposed works are not inconsistent with any of these actions and considering the threats posed by the proposal to habitat, this effect is not anticipated.

D2.2 Migratory species

Rainbow Bee-eater, Fork-tailed Swift, White-throated Needle-tail

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

a) substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species,

This effect is unlikely. The vegetation onsite will remain much as before the development over most of the site. It is anticipated that the grazing of the site will continue (although this report makes recommendations to reduce the level of grazing). It is expected that a Construction Environmental Management Plan would specify soil and water controls, weed controls and hazardous spill controls to be employed during construction; hence the site would not be substantially modified with respect to potential habitat for these species.

The installation of the turbines may act as a barrier to movement on a very local level, however, considering the range and manoeuvrability of these species, and the distances over which they range, the turbines are not be anticipated to impact the accessibility of important habitats. Breeding habitat would not be affected for either species.

b) result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species,

The development would not have this effect; vegetation will remain much as before the development over most of the site. Sediment erosion and weed controls would be implemented to ensure that weed species are not encouraged further by the development.

c) seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

There is potential to impact the life cycle of these species via collision mortalities during migration. There is also potential to affect foraging and movements around the site. The White-throated Needletail and Fork-tailed Swift can occur in large numbers, increasing the risk of the impact disrupting a significant proportion of a population of these species. The risk is lessened by limited time they could be expected to spend at the site and the capacity to habituate to humanised landscapes.

The Rainbow Bee-eater is known to breed in drainage lines in the local area and congregate in small groups at this time. This habitat would not be affected by the proposal to the extent that a significant proportion of the local population would be affected.

Local migration routes are not known. Monitoring will be required to ensure that mortality levels do not reach unacceptable levels without action being taken. With rigorous monitoring in place, this uncertainty can be addressed.

D.3 Conclusion of assessments of significance

These assessments have shown that, without the adoption of mitigation measures, there could be potential for the proposed works to generate lifecycle impacts sufficient to affect local viable populations (if present onsite) for 16 of the 29 species considered. The risk relates to:

- Loss or modification of important habitat - four species

  (Tawny Rock Dragon, Ringed Brown Snake, Slender Mallee Blue-tongue Lizard, Marble-headed Snake-lizard, Woma)

- Ongoing collisions with turbine infrastructure – 12 species

  (Pink Cockatoo, Scarlet-chested Parrot, Painted Honeyeater, Pied Honeyeater, Masked and Barking Owls, Grey Falcon, Black-breasted Buzzard, Square-tailed Kite, Inland Forest Bat, Yellow-bellied Sheathtail-bat, Little Pied Bat)

The assessment identifies habitat and habitat features important to threatened species onsite as rocky outcrops, spinifex grasslands and the Barrier Range ridge system (for wide ranging raptors). The assessment also identifies a common threat to several species, that being habitat degradation caused by heavy grazing in combination with drought.

Based on the above assessment, **ngh**environmental consider that a significant impact on the subject species can be avoided by the implementation of a number of controls:

- Avoidance of Spinifex grasslands where possible. This is important habitat for the populations of Marble-headed Snake-lizard and Slender Mallee Blue-tongue Lizard which are significant in the bioregion. Mapping of habitat for these species is provided in this report.
- Further survey and habitat of the Tawny Rock Dragon in the Stage 1b and 1c areas. Areas of significant rock outcropping have been mapped by aerial photograph interpretation, and will be ground-thruthed and assessed for their significance to the rock-obligate Tawny Rock Dragon. Avoidance of key hot spots for the Tawny Rock Dragon would be recommended.
- Design and implementation of specific erosion and sediment controls to ensure that landforms are not destabilised and erosion is not increased onsite. This may rely on site

specific physical controls to stabilise slopes. Landforms in many areas are steep and unstable and as revegetation will not be a viable means to stabilise landforms in the short to medium term. Physical methods designed to trap soil and moisture and stabilise slopes will provide the best potential for natural regeneration in the long-term

- Clusters of rocks and boulders should be avoided where possible. Where rocks and boulders cannot be avoided, they should be placed directly adjacent to the works area to preserve the availability of refuge
- Standing dead trees and woody debris should be avoided where possible. Where they must be moved to allow for the tracks and hardstand areas, they should be placed adjacent to the impact areas, to retain these refugia in the immediate area
- There would be benefits for several subject species in controlling heavy grazing by feral goats onsite. Implementation of a feral goat management program as part of the development of the wind farm site would assist in offsetting environmental impacts and halt the degradation that heavy goat grazing is causing across many areas of the site
- An adaptive management monitoring program should be designed to document mortalities, remove carcasses and assess the effectiveness of controls. Timing should be specific to the most at-risk target species. Standardised data should be collected to increase the knowledge base on this subject and it should be made publicly available. If mortalities exceed a pre-determined threshold (set out in the monitoring program), additional mitigation measures should be considered, such as further turbine ridge habitat modification and enhancement of off-site habitats

APPENDIX E: BIRD AND BAT RISK ASSESSMENT

This risk assessment examines relevant background information and then evaluates the risk of significant impact posed by the proposed wind farm in terms of:

- Collision with wind turbines, or 'bladestrike'. For these purposes, 'bladestrike' refers to mortality caused by direct collision with turbine blades and by birds being swept down by the wake behind a turbine blade
- Behaviour modification, for example avoidance of foraging areas due to the presence of the turbines and associated infrastructure

The risk assessment is qualitative, combining assessments of likelihood and consequence to produce a final risk assessment of low, moderate or high risk for selected species. Likelihood incorporates biological, behavioural and environmental risk factors. Consequence includes the significance of habitat loss and bladestrike in terms of habitat rarity and importance, population impacts, recovery potential and species conservation status. The assessment draws on the Interim Standards for Risk Assessment relating to birds and wind farms (Brett Lane and Associates 2005) and the Australian Standards for Risk Assessment (AS/NZS 4360). It should be read in conjunction with the Biodiversity Assessment (**ngh**environmental 2008a), which details the experiences at existing wind farms, collision risk factors and habitat utilisation impacts.

The risk assessment focuses on bird groups which have been shown to be at particular risk in studies at other wind farms (raptors, waterbirds, migratory species), as well as rare, threatened or protected birds and bats with potential to be present in the study area.

<table>
<tr><th colspan="3">Wedge-tailed Eagle Aquila audax (non threatened)</th></tr>
<tr><td colspan="3">Risk factors
Observed at site
Utilises updrafts around the range when foraging (at blade height)
Large home range
Male diving displays
Prey source present at turbine sites (goats and rabbits)
Low reproductive rate</td></tr>
<tr><td colspan="3">Discussion
Widely distributed, sedentary. Constructs large stick nests in trees. Utilises updrafts around the range when foraging (at blade height). Observed singly and in a pairs soaring over the range and taking flight from within the turbine envelope. Feeds on birds, rabbits, small mammals. Rabbits and goats are local food sources. Rabbit warrens are present on the plains and goat nurseries on rocky outcrops. Important resources are concentrated within the range and adjacent area. Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat.
Mortalities for the related Golden Eagle in US due to presence of prey around turbines (Thelander et al. 2003). Turbines with lower blade reaches were most deadly to Golden Eagles. Wedge-tailed Eagles have collided with turbines in Tasmania, South Australia and Victoria. Raptors continue to be present within 1 km of the Crookwell I turbines (URS 2004). At Toora (Vic.), Wedge-tailed eagles were regularly observed before and after operations began at this site. Eagles were observed to avoid the turbines by flying around or between them, but not into them (Brett Lane and Associates 2005). During bird behaviour surveys at Codrington, Wedge-tailed eagles were observed to avoid turbines by flying horizontally around them (twice) and turning and not entering the turbine area (Biosis Research 2002). The species has also been observed flying safely between turbines at the Toora wind farm (Wonthaggi EES Panel 2003). Collisions are not expected to be frequent or in excess of the reproductive and dispersal capacity of the regional population.</td></tr>
<tr><td colspan="2">Likelihood of habitat avoidance: possible</td><td>Habitat importance: moderate-high</td></tr>
<tr><td colspan="2">Collision likelihood: rare</td><td>Collision consequence: minor-moderate</td></tr>
<tr><td rowspan="2">Overall risk levels</td><td>Individuals</td><td>Moderate</td></tr>
<tr><td>Population</td><td>Moderate-high</td></tr>
</table>

Australian Kestrel *Falco cenchroides* (non threatened)		
Risk factors Forages in open country at blade height Family parties play in air currents		
Discussion Sedentary or nomadic. Observed foraging on the plains and around the ranges of the proposal. Nests in tree hollows (limited to drainage lines around the ranges). Has been known to collide with aircraft when hunting at airports, but have a relatively rapid reproductive rate (URS 2004). The species is relatively common at the Woolnorth and Codrington wind farm sites and no collisions have been recorded at those sites. Should have the capacity to habituate to turbines over time.		
Likelihood of habitat avoidance: possible		*Habitat importance: low-moderate*
Collision likelihood: rare		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Low-moderate***
	Population	***Low***

Brown Falcon *Falco berigora* (non threatened), Grey Falcon *Falco hypoleucos (threatened)*		
Risk factors Performs tumbling and diving flight displays Soars on thermals Potential to flock		
Discussion The Brown Falcon inhabits open woodland and grassland including arid areas and farmland. Sedentary. Gathers in sometimes large flocks post-breeding, especially at fires and locust and mouse plagues, sometimes with other raptors. Pairs occasionally hunt cooperatively. Makes sloping descent to catch prey on ground (Pizzey 1985). Feeds on carrion but takes mostly live prey: mammals, birds, reptiles (especially snakes), amphibians, and large insects. Nests in nest of crow or hawk, makes own stick nest or uses tree hollows. A Brown Falcon mortality has been reported from the Codrington wind farm (Biosis Research 2002). This species appears able to adapt and habituate to human developments. Observed foraging within the development envelope at turbine height over plains and ranges. Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat. The Grey Falcon is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. It utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse. Trees, dead or alive, containing stick nests such as those of raptors, crows and ravens are required for breeding. It may be seasonal or irregular visitor to areas.		
Likelihood of habitat avoidance: possible		*Habitat importance: low*
Collision likelihood: possible		*Collision consequence: low-moderate*
Overall risk levels	***Individuals***	***Moderate***
	Population	***Moderate***

Peregrine Falcon *Falco peregrinus* (non-threatened)		
Risk factors Chases prey and dives at high speed within turbine height Forages at dawn and dust (low light conditions)		
Discussion Habitat most commonly gorges and timbered watercourses, generally near rivers and swamps. Nests on rock crevice, bare ledge, tree hollow or old corvid nest, also on spires and tall buildings (Pizzey 1985). This species appears able to adapt and habituate to human developments. Feeds almost exclusively on medium sized birds but will hunt small mammals, including bats. Hunts at dawn and dusk, when prey are most active. Prey is struck and captured in mid-air. Potential habitat occurs in the area although the species is not known from the area. Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat. Several records are present from Mutwintji National Park to the north-east.		
Likelihood of habitat avoidance: possible		*Habitat importance: low*
Collision likelihood: low		*Collision consequence: low*
Overall risk levels	***Individuals***	***Low-moderate***
	Population	***Low***

Australian Hobby *Falco longipennis* (non-threatened)		
Risk factors Forages in open country at blade height Fast pursuit of flying birds and insects		
Discussion Range of open habitats, typically woodland with large trees and timbered watercourses. Builds stick nest in top of tall trees. Hunts small and medium sized birds (including ducks and herons) and flying insects. Appears able to adapt and habituate to developed environments. Known from the Western Division. Preferred habitat features (trees near watercourses and woodland) may attract this species to the development envelope. Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat.		
Likelihood of habitat avoidance: possible		*Habitat importance: low*
Collision likelihood: possible		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Moderate***
	Population	***Low***

Spotted Harrier *Circus assimilis (non-threatened)*		
Risk factors Forages in open country at blade height		
Discussion Nomadic or migratory. Soars high and very low over open country. Constructs large stick nest in eucalypts. Known from the Western Division. The site represents marginal habitat.		
Likelihood of habitat avoidance: possible		*Habitat importance: minor*
Collision likelihood: possible		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Moderate***
	Population	***Low***

Owls: Barking Owl *Ninox connivens*, Masked Owl *Tyto novaehollandiea*, Grass Owl *Tyto capensis* (threatened); Barn Owl *Tyto alba* (non-threatened)		
Risk factors Night-flying Large ranging		
Discussion Top order predators at low density in the landscape. Limited by the distribution of refuge including hollow-bearing trees, mature vegetation, dense vegetation and for the Grass Owl, tall understorey vegetation. These species have varied diet and large home range, hunting in grasslands, in open areas and in the tree canopy for mammals and birds (NPWS 2003b). Preferred habitat features may attract this species to the development envelope. Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat. Forest owls are generally confined to areas with tree cover, although dispersing juveniles may fly over open country. Hunting flights are likely to be at ground and canopy level. These species are unlikely to enter the bladeswept zone during hunting flights. Dispersal is likely to be at greater heights however, presenting a risk of bladestrike.		
Likelihood of habitat avoidance: rare		*Habitat importance: low*
Collision likelihood: rare		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Low-moderate***
	Population	***Low-moderate***

Tawny Frogmouth *Podargus strigoides* (non-threatened)		
Risk factors Night-flying Occur in small family groups		
Discussion Inhabits heavy forests to open woodlands, timber along watercourses in inland areas. Nests in flimsy stick platforms on branches 5-10m high. Sedentary (Pizzey 1985). Active at dusk, takes prey from sitting position from ground surfaces such as roads. Feeding activities are more likely of the site in timbered lowlands, and would generally occur below blade height. Several observed in a water course at the base of the range. Unlikely to fly in the path of blades.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Low***
	Population	***Low***

Diamond Firetail *Emblema guttata* (threatened)		
Risk factors Seasonal flock aggregations Declining		
Behaviour and ecology Sedentary. Restricted largely to woodland remnants of grassy eucalypt woodlands and sometimes lightly wooded farmland. Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde & Tidemann 1986), nesting in pairs or communally in shrubs and small trees. May form large flocks during winter and autumn. Research in grazing landscapes in southern NSW suggests that granivores prefer to move along densely vegetated areas (Fischer and Lindenmayer 2002a). Diamond Firetails are considered to have poor dispersal abilities and are likely to be less common away from tree cover.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: moderate*
Overall risk levels	***Individuals***	***Low***
	Population	***Moderate*** *(due to flocking behaviour)*

Parrots: Scarlet-chested Parrot *Neophema splendida,* Night Parrot *Pezoporus occidentalis* (threatened)		
Risk factors Migratory (seasonal) Limited flocking Declining Nocturnal (Night Parrot)		
Discussion The Scarlet-chested Parrot inhabits arid to semi-arid areas within mallee Mulga scrublands/open woodlands with Spinifex and saltbush ground covers. Forages on or near the ground for seeds of grasses, including Spinifex, herbs and acacias. Usually nests close to the ground within small trees. Several pairs may nest within neighbouring trees. These birds band into quite large flocks when not breeding and become highly nomadic (DECC 2007). The Night Parrot is thought to have a dependence upon dense Spinifex or samphire for daytime roosting spots and for nesting. Although the Night Parrot is capable of flight, it prefers to spend most of its time on the ground. Some reports indicated that it runs between shelter when possible, in preference to flying. When it flies, it usually goes only a short distance, flying close low, before landing and escaping on foot (DECC 2007). These species are unlikely to fly over the ridges into the path of turbines, preferring to forage and disperse using vegetated corridors and / or grassland habitats.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: moderate*
Overall risk levels	***Individuals***	***Low***
	Population	***Moderate*** *(due to flocking behaviour)*

Pink Cockatoo *Cacatua leadbeateri* (threatened)		
Risk factors Rapid flight at turbine height Flocking Declining		
Discussion Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, on the seeds of native and exotic melons, saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nests in tree hollows (DECC 2007). Observed on site flying with the turbine envelope at blade height. A manoeuvrable flyer. Key habitat is not located within the development envelope.		
Likelihood of habitat avoidance: possible		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Low***
	Population	***Moderate***

Painted Snipe (*Rostratula benghalensis*) (threatened)		
Risk factors Migratory Potential habitat adjacent to site Declining		
Discussion Little is known of the behaviour of this cryptic waterbird. Possibly nomadic; has been observed occupying ephemeral wetlands. Seeds and invertebrates are foraged for on the waters edge. Breeding is thought to occur in response to local conditions between September and December (Pringle 1987). A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory wetland species concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006). Habitat is marginal at the site, likely to be limited to infrequent wet years, on surrounding plains. This species does not appear to congregate in large numbers.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: moderate*
Overall risk levels	***Individuals***	***Low***
	Population	***Low***

Latham's Snipe, Japanese Snipe (*Gallinago hardwickii*) (threatened)		
Risk factors Migratory Potential habitat adjacent to site		
Discussion This species nests annually in northern Japan, where it congregates in large numbers on the shores of local lakes (Schodde & Tideman 1995). Favoured habitats during the non-breeding season include wet paddocks or shallow water with good covering of tussocks or other growth, seepage below dams, from sea level to 2000m (Pizzey 1985), where they probe for aquatic invertebrate and seed (Green & Osborne 1994). A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory wetland species such as Lathams Snipe, concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006). Habitat is marginal at the site, likely to be limited to infrequent wet years, on surrounding plains. This species does not appear to congregate in large numbers.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: moderate*
Overall risk levels	***Individuals***	***Low***
	Population	***Low***

Ducks: Blue-billed Duck *Oxyuro australis*, Freckled Duck *Stictonetta naevosa* (threatened)		
Risk factors Flocking Swift flight, possibly with poor manoeuvrability Wide ranging Declining		
Discussion The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. The Freckled Duck similarly prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Habitat within the development envelope is not suitable although Umberumberka Dam may be periodically utilised. Movement corridors are anticipated to be largely confined to vegetated corridors. While migration routes are not known, periodically, flocks may pass within the turbine envelope. Overseas studies have shown that some waterbird species are able to perceive and avoid turbines, both during the day and at night (Erickson *et al.* 2001). Because of their capacity to avoid turbines, the US National Wind Coordinating Committee (2000) considers waterbirds to be at lower risk from bladestrike than some other groups.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: Moderate*
Overall risk levels	***Individuals***	***Low***
	Population	***Moderate***

Egrets: Cattle Egret *Oxyuro australis*, Great Egret *Stictonetta naevosa* (non-threatened)		
Risk factors Possibly with poor manoeuvrability Wide ranging		
Discussion The Cattle Egret is a wide ranging species, found in dry grassy habitats where it feeds on insects. It is usually found large animals which disturb insects. No Cattle Egrets were observed onsite. The Great Egret is partially migratory. It is found feeding in shallow water or drier habitats on fish, frogs or insects. It breeds in colonies vegetation near permanent water. Overseas studies have shown that some waterbird species are able to perceive and avoid turbines, both during the day and at night (Erickson *et al.* 2001). Because of their capacity to avoid turbines, the US National Wind Coordinating Committee (2000) considers waterbirds to be at lower risk from bladestrike than some other groups.		
Likelihood of habitat avoidance: rare		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: minor*
Overall risk levels	***Individuals***	***Low***
	Population	***Low***

White-throated Needle-tail *Hirundapus caudacutus* (non-threatened)		
Risk factors Migratory High-flying Vertical flight and diving displays May form large flocks		
Discussion Summer migrant to Australia from Asia, mid-October to mid-April. Feed on flying insects. Occurs over cities. Roosting habits not known. Risk is lessened by limited time spent at the site and capacity to habituate to humanised landscapes. Local migration routes are not known. A recent assessment of collision risk on 34 bird species present at five operational and planned wind farm sites in Gippsland, Victoria, including migratory species such as the White-throated Needletail, concluded that potential impacts are likely to be negligible or low for these species (Biosis Research 2006).		
Likelihood of habitat avoidance: rare-possible		*Habitat importance: minor*
Collision likelihood: rare		*Collision consequence: minor-moderate*
Overall risk levels	***Individuals***	***Low-moderate***
	Population	***Low***

Bats: Yellow-bellied Sheathtail-bat *Saccolaimus flaviventrus,* Inland Forest Bat *Vespadelus baverstocki* , Little Pied Bat *Chalinobus picatus* (threatened)
Risk factors Colonial Forage and disperse within bladesweep area Declining
Discussion The Yellow-bellied Sheathtail-bat was recorded as a single anabat record near Mt Robe. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn. The Inland Forest Bat is recorded from scattered localities in western NSW, but may be more widespread. Roosts in tree hollows and abandoned buildings. It has been recorded from a variety of woodland formations, including mallee, Mulga and River Red Gum. Colony size ranges from a few individuals to more than fifty. Females congregate to raise young. The single young is carried by its mother until its weight affects her flight, and is then left in the roost at night. These bats fly rapidly and cover an extensive foraging area. The Little-Pied Bat was recorded at Umberumberka Dam in the 2007 surveys, and generally occurs in dry open forest, open woodland, Mulga woodlands, chenopod shrublands, cypress-pine forest, or mallee. It roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings and can tolerate high temperatures and dryness but need access to nearby open water. Potential for collisions exists, although the turbine areas represent marginal foraging habitat. The former two species

would roost away from turbines, in tree hollows while the latter has potential to roost in caves or mine shafts occurring closer to the turbine envelope. Dispersing individuals rather than acclimatised resident bats have been found to be at increased risk of collision (Erickson *et al.* 2002).		
Likelihood of habitat avoidance: possible		*Habitat importance: low*
Collision likelihood: rare		*Collision consequence: low-moderate*
Overall risk levels	***Individuals***	***Low***
	Population	***Low-moderate***

Conclusion

The risks of collision with wind farm infrastructure for birds and bats relate to species ecology, environmental conditions and structural characteristics of the infrastructure proposed. Behaviour modification, such as avoiding migration routes or foraging or breeding areas, relates to the how the site is developed (the degree to which indirect and offsite impacts are managed), the distribution of important habitat features (for example, roost sites) and more species specific factors, such as whether species may find perch opportunities or be scared off by turbines.

The risk assessment tables above have rated threatened species and other species considered to be at risk. No species was rated high. The most at risk species were determined to be the Wedge-tail Eagle and Brown Falcon. Both species are known to occur in the study area, have preferred resources within the development envelope, occur at low density in the landscape and would represent excellent species to model the specific impacts of the proposal post construction.

APPENDIX F: PHOTOGRAPHS OF THE SITE

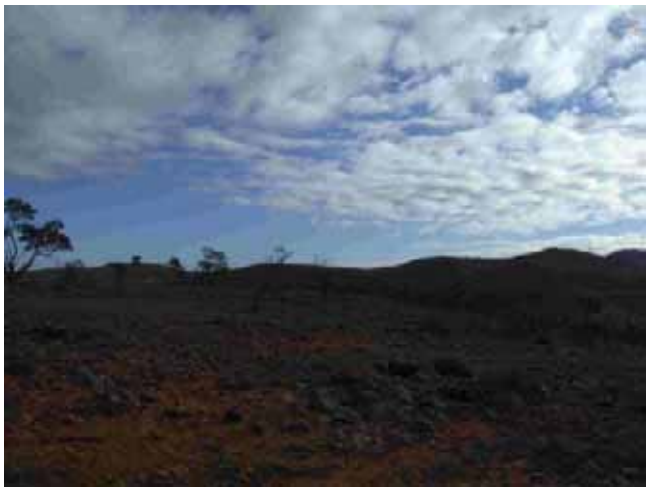
Photograph 1. View south from monitoring tower north of Mount Robe

Photograph 2. View toward Mount Franks

Photograph 3. View from monitoring tower access track towards Umberumberka dam

Photograph 4. The hills directly north of Umberumberka Dam are sparsely vegetated

Photograph 5. Funnel traps used to trap reptiles and small mammals east of Mt Robe



Photograph 6. Main north ridge in south-west section of Stage 1b

Photograph 7. Waterhole just north of Umberumberka Dam

Photograph 8. River Red Gum lined drainage lines provide numerous hollows suitable for birds and bats

Photograph 9. Slender Mallee-blue tongue (*Cyclodomorphus melanops*) captured in spinifex grass

Photograph 10. Marbled-headed Snake-lizard (*Delma australis*) captured in spinifex grass

Photograph 11. Spinifex grass was found amongst Prickly Wattle creek lines along the transmission line easement between Mt Franks and Lakes Knob

Photograph 12. Natural Caves such as south of Mt Franks were also found in the Stage 1c area

Photograph 13. Another natural waterhole near Mt Franks showing heavy use by feral goats

Photograph 14. Vegetation was sparse on the western side of the Stage 1c area

Photograph 15. Porcupine Grass - Red Mallee - Gum Coolibah hummock grassland / low sparse woodland to the east of the north-south transmission line easement.

Photograph 16. Mulga not yet showing signs of dieback are uncommon on the ridges.

Photograph 17. Ephemeral drainage lines are common around the lower parts of the study area

Photograph 18. Main western ridge in southern section near Umberumberka dam. Note the condition of the Mulga which is typical across the southern parts of the study area

Photograph 19. Looking south in the lower section of Stage 1c

Photograph 20. Bynoes Prickly Gecko are common in the study area

Photograph 21. Male Tawny Rock Dragon *(Ctenophorus decressi)* observed in the western section of Stage 1c

Photograph 22. White-browed Babbler recorded near Mt Franks

Photograph 23. Shingleback lizards are common in the study area particularly around creeklines where a diverse ground flora is more abundant

Photograph 24. Feral goats were widespread across the study area

Photograph 25. Fallen timber provides terrestrial fauna with important microhabitat

Photograph 26. Wedge-tailed eagles are common in the study area

Photograph 27. Bluebush shrubland on the proposed powerline route